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Systematic account of a collection of fishes from the Mongolian People's Republic: with a review of the hydrobiology of the major Mongolian drainage basins

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CONTENTS

INTRODUCTION

The Mongolian People's Republic (MPR) occupies over one and a half million km^2 of high, central Asia. Zoogeographically, this is a unique position as the country encompasses within its borders part of the three major Central Asian drainage systems; the Arctic, Pacific and Central Asian Internal basins.

Despite the country's unique position, the fishes of Mongolia are poorly known. Original descriptions by Russian and Mongolian authors and other references in the scientific literature are widely scattered and often inaccessible, particularly to western scientists.

It is hoped that the publication of a series of volumes entitled '*The Vertebrates of the Mongolian People's Republic*' of which the first two were devoted to fishes (Shatunovskii, 1983 & 1985; issued in Russian) will improve this situation. A proposal for the translation of these volumes from the original Russian into English, has been submitted to the Smithsonian Institutions Library, Translation Publishing Program.

Historical review

The earliest collection of fishes known from Mongolia was made by the German naturalist Peter Simon Pallas (1774–1811); see Cuvier (1819) for a discussion of his scientific activities.

Pallas undertook his pioneering travels through eastern Russia and Siberia during his tenure of the Chair of Natural History at the St. Petersburg Academy of Sciences (Svetovidov, 1981). From the valuable collections of skins and alcohol-preserved specimens sent back to St. Petersburg from Mongolia he was able to describe the salmonids *Hucho taimen* (Pallas, 1773), *Brachymystax lenok* (Pallas, 1773), *Thymallus arcticus* (Pallas, 1776) and cyprinids *Hemibarbus labeo* (Pallas, 1776), *Rhodeus sericeus* (Pallas, 1776) and *Pseudaspius leptocephalus* (Pallas, 1778).

Exploration of this region was continued during the last century, notably by Dybowski (1869, 1872 & 1876), Basilewsky (1855), Kessler (1878) and Warpachowski (1889); their work included the description of many new species.

The start of this century saw the first of numerous studies on the fishes of the region by Berg (e.g. 1909), which

Fig. 1 Professor Anudarin Dashdorzh (1910–1976)

eventually led to his classic monograph on the *Freshwater Fishes of the U.S.S.R. and Adjacent Countries* (Berg, 1916; original edition in Russian). This work has passed through four editions and remains the standard reference to the majority of fishes from Mongolia despite the recent publications discussed above.

The founding in Ulan Bator of the Mongolian State University (1942) and the Institute of Biology of the Academy of Sciences (1965) greatly increased local research on the rich fauna of the country's lentic and lotic aquatic environments. The first Mongolian to hold the Chair of Zoology, Professor A. Dashdorzh (Fig. 1) had a particular interest in the fishes of his native land (e.g. Dashdorzh, 1955 & 1962; Dashdorzh, Dulma & Pivnička, 1963; Dashdorzh & Tomilov, 1965).

The first expedition to be organised from the west occurred during the first half of this century with the First, Second and Third American Museum of Natural History Asiatic Expeditions. These spent several summer months between 1922 and 1930 in the south and western Gobi. A small collection of fishes was obtained by Roy Chapman Andrews and his colleagues; they recognised two distinct forms of *Oreoleuciscus* from isolated Gobi basins (Andrews, 1932: 121 & 298). This material was briefly mentioned by Nichols (1930), but it has never been fully described and was beyond the scope of his monograph '*Freshwater Fishes of China*' (Nichols, 1943: V).

Since the time of these multidisciplinary expeditions to the Central Asian Internal basin, and a small region of the Arctic basin (Andrews, 1932: 54), only a few specimens have been received by western museums and institutions concerned with taxonomic research (e.g. British Museum [Natural History]). There have been no other expeditions from the west and none solely devoted to the study of Mongolian fishes, until that reported upon here.

Recent times have seen joint Soviet-Mongolian (1946 & 1948–9 and from 1970 to the present), Polish-Mongolian (1962–1965 & 1967–1971), Czechoslovakian-Mongolian (1966) and German Democratic Republic-Mongolian (1964–1970) collaboratory scientific field studies. However, these have tended to concentrate on geological, palaeontological or broad multidisciplinary biological studies (Vasil'eva, 1985 and see listings for Mongolia in *Bibliography and Index of Geology* from 1969 to date). They have contributed to our understanding of the taxonomy of some species, by providing new collections of fishes for analysis by ichthyologists in the countries concerned (e.g. Holčik & Pivnička, 1968; Chitravadivelu, 1970).

Collecting strategy

The bulk of the ichthyological fieldwork in Mongolia extended from 7 August to the 5 September 1984. It was restricted to 10 principal localities (numbered on Fig. 2), partly due to the geographical and political isolation of many regions (especially the border areas), and because transport and fuel were in such short supply.

The major objective of the survey was to collect samples and comparative ecological data from waters in each of the three distinct drainage basins. To achieve this with the limited facilities available, the field programme consisted of two main components; a three week expedition west of Ulan Bator to visit sites in the Arctic and Central Asian or Internal drainage basins, and a single week's expedition east of the capital to visit a further locality with Arctic drainage as well as the major Mongolian river system in the Pacific drainage basin.

Materials and methods

A Russian built Gaz 69 Jeep and coupons for 400 litres of diesel fuel were provided by the Mongolian Ministry of Transport, together with a driver/mechanic. A member of the Biology Department at the Mongolian State University acted as local guide and interpreter.

Collections were made with sinking and floating gill nets of mesh sizes ranging between 1–10cm; these were employed extensively. Rotenone, beach seine and dip nets were used if suitable conditions prevailed. Water salinity was measured with a portable conductivity meter and the water clarity in the two lakes with the aid of a Secchi disc which was also used to measure depth. The temperature of the water was read from a suspended mercury thermometer. The elemental compositions of the salt samples taken from the margin of an isolated water body of Boon Tsagaan Nuur (Nuur = Lake) in western Gobi were determined with a Jerrell-Ash Model, 750 Atom-Comp direct reading ICAP (Inductively Coupled Argon Plasma) Spectrophotometer, using dilutions of Fischer Scientific absorption stocks for standards. The English spelling of place names follows that generally adopted in scientific publications, or from maps in Bartholomew's World Travel Series and British Ministry of Defence Operational Navigation Charts (ONC E7–8 & F7–8)

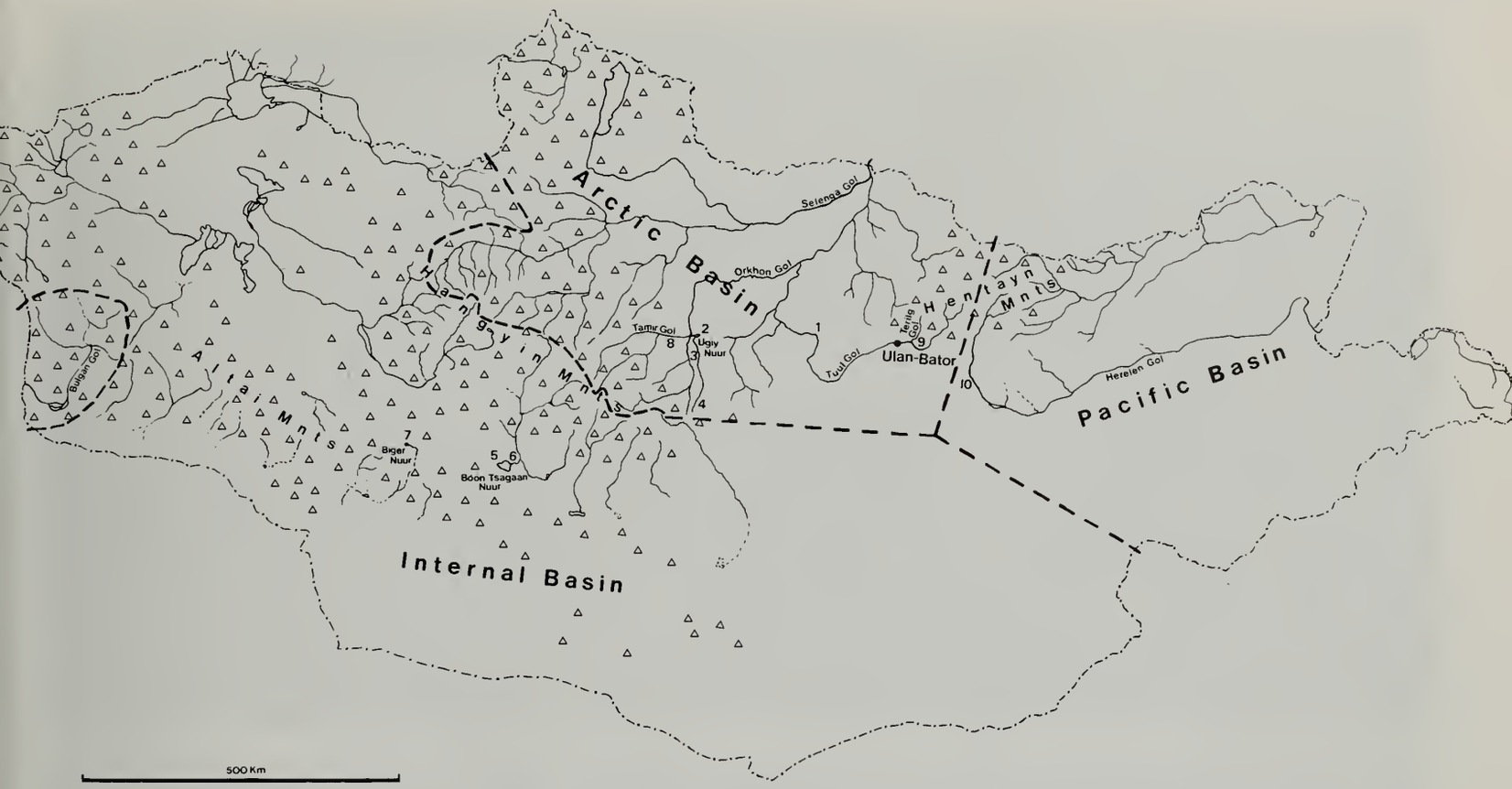


Fig. 2 Map of the Mongolian People's Republic to show major mountain ranges (△), rivers (=Gol) and lakes (=Nuur). The three main drainage basins are outlined and the principal collecting localities are numbered: 1. Tuul Gol; 2. Ugiy Nuur; 3. Orkhon Gol; 4. Hogshin Orkhon Gol; 5. Boon Tsagaan Nuur; 6. Tsagaan Gol; 7. Biger Nuur; 8. Tamir Gol; 9. Terilg Gol; 10. Herelen Gol.

HYDROBIOLOGY OF MONGOLIA

Past conditions

Mongolia lies in the mountainous central Asian plateau that is a geographical transition zone between the Siberian taiga and dry steppe and desert of central Asian Gobi (Mitcheli, 1967; Petrov, 1970; Jagchid & Hyer, 1979; Saunders, 1987).

The origin of Mongolia's present-day hydrobiology can be traced back to the Cretaceous (Berkey & Morris, 1927; Martinson, 1955). In the lower Cretaceous, an enormous inland lake had widened to the north as a continuous system connecting what are now the disparate Altai and Hangyin basins, and formed inner basins of the type found in Recent times around the Aral and Caspian seas (Dulma, 1979). This continuous lake system is thought to have extended by the middle Cretaceous from what is now the Pacific eastern seaboard across Manchuria and Central Asia into the western Gobi basin of Mongolia (Fig. 2). Geological studies (e.g. Maleyev, 1955 and Martinson, 1968) reveal that a large central Asian freshwater system existed in the upper Cretaceous. This was responsible for sedimentary deposits rich in palaeontological remains. Grabau (1931), Andrews (1932), Kielan-Jaworowska & Dorchin (1968) and Kielan-Jaworowska & Barsbold (1972) described primitive mammals, dinosaurs and other reptiles from the shores of this system; for recent reviews of Mongolian Paleogene deposits see Russell & Zhai (1987) for mammals and Sytchevskaya (1986) for fishes.

This great central Asian basin is thought to have broken-up by the end of the Cretaceous. The modern topography was then shaped by alpine orogenesis at the end of the Pleistocene (Petrov, 1976).

These tectonic movements produced the three mountain ranges that dominate the local scenery (i.e. Altai, Hangyin and Hentayn). Their folding and subsequent shaping are the chief factors responsible for the present-day hydrographical network of the region.

The drainage basins within the borders of the MPR are clearly defined by the mountain ranges that subdivide the country (Fig. 2). Four of the zoogeographical subdivisions of the USSR and adjacent countries defined by Berg (1948) extend in part across the territory of Mongolia. Three of these were considered by Berg (1948, coloured map) to lie within the Holarctic region. They consist of the Arctic province, within his Circumpolar subregion, and the West Mongolian and Tarim provinces, in his Asiatic Highland subregion. The fourth Mongolian faunal region defined by Berg (1948) is the Amur province, within his Amur Transitional region. His analyses relied solely upon comparison of fish faunas from distinct water bodies and drainage basins in these areas.

More recent comparisons between the aquatic faunal compositions of Mongolian zoogeographic provinces based largely on planktonic and ichthyological surveys (Dulma, 1979; Shatunovskii, 1983; Dgebuadze, 1986), suggest Berg's Tarim and West Mongolian provinces should be united zoogeographically even though they are now hydrologically isolated. Evidence from recent tectonic reconstructions of the area support their amalgamation.

Present drainage systems

Arctic Basin

The Mongolian part of the Arctic province consists of three major river systems with associated lakes and tributaries; the Bulgan, Shishlid and Selenga. Together they have a total

Fig. 3 Principal collecting localities; (Above) Tuul Gol, 5 km north of Lun and (Below) Tamir Gol, 2–3 km upstream from confluence with upper reaches of Orkhon Gol.

catchment area of 323,000 km^2 or 20.6% of the whole country (Dulma, 1979).

The Bulgan River system drains the southern slopes of the Altai mountain range. It is separated from the other part of the Mongolian Arctic basin by the western Gobi valley. These waters support a fauna that is almost indistinguishable, although the Bulgan River now empties into Lake Ulungur Province (People's Republic of China) which has no outlet and is an enclosed system (endorheic). The isolation of this system may have occurred during uplift of the Altai mountain range which divided the Central Asian basin (discussed below).

The Shishlid River system is a relatively short headwater of the Yenisei River and occupies the most northern tip of Mongolia, just west of Khbsugul Nuur.

The Selenga River system is the largest in the Mongolian Arctic basin; it encompasses 87.3% of the basin, has a drainage area in excess of 280,000 km^2, a total length of about 1,500 km and supplies 50% of the affluent of Lake Baikal (Kozhov, 1963). The Selenga's tributaries consist of many large rivers and lakes (e.g. Terilg, Tuul, Orkhon & Tamir Gols and Khbsugul, Terhiyn and Ugiy Nuurs). It is the principal headwater of the Yenesei River which courses across Siberia before eventually emptying into the Arctic Ocean.

Fig. 4 Principal collecting localities; (Above) Orkhon Gol, 1 km upstream from bridge at Harhorim (Karakorum) and (Below) Terilg Gol, at end of vehicle track 35 km east of Ulan Bator.

The six principal Arctic basin localities visited during the course of my survey were all confined to the Selenga system. They consisted of five rivers and one lake. The rivers sampled in this northern basin fall into three types: 1) medium level with slow current, deep turbid water over a detritus covered substrate, supporting dense macrophyte growth (e.g. Tuul

Fig. 5 Principal collecting locality Ugiy Nuur, 1 km west of outlet into Orkhon Gol. (Above) Beach seining along southern shore and (Below) swamp region prior to outlet into Orkhon Gol.

and Tarim Gols: Fig. 3); 2) high altitude 'salmon rivers' (Odum, 1978: 298) with fast flowing, clear water over a stony, gravel substrate with little rooted aquatic vegetation (e.g. Orkhon and Terilg Gols: Fig. 4); and 3) narrow head-water streams that course across high altitude alpine meadows and consist of deeper pools and riffles (e.g. Hogshin Orkhon Gol: Fig. 2 locality 4). Generally they have grassy banks and wide flood plains, with small rivulets and ponds. The water level was often high, with increased current and flooding at several localities. This was due to the high precipitation during the months of July and August in northern parts of Mongolia (Petrov, 1970). The sparse vegetation allows rapid run-off which results in dramatic changes in water level following short but heavy periods of rainfall.

The only lake sampled in the Selenga system was Ugiy Nuur (Fig. 5). It is an elongated mesotrophic lake covering an area of 2.5 km^2 and appears to have been formed by the dislocation of the Orkhon Gol in a shallow valley on the northern margin of the Hangyin mountain range (Fig. 2; locality 2). Its greatest depth is 16 m and water transparency 3 m. Clear, shallow water constitutes 40% of the total lake area and it is thought about 50% of the lake bottom supports macrophytic plants (Dulma, 1979: 716 and *pers. obs.* underwater).

Rooted macrophytes were found to be particularly dense in the effluent region of the lake; large predatory species (e.g. *Esox*) were common in this area. Dulma (1979) considered the lake to be ichthyologically a 'roach-pike type' and listed its 'useful fish species'.

Pacific Basin

The major lentic waters of the Mongolian Pacific basin consist of Buyr and Holi Nuur, the principal lotic waters are the Onon Gol, Herelen Gol, Halhin Gol and Uldra Gol. The Herelen Gol is the largest river and runs 550 km from its source in the Hentayn mountains to Dalai Nuur. This river together with the Onon, forms the Mongolian headwaters of the Amur River system which eventually flows into the Sea of Okhotsk and the Pacific Ocean. The connection of the Herelen with the upper reaches of the Amur is subject to seasonal fluctuations. Dalai Nuur (Hu-lun Ch'ih) is bound by marshland to the east and north of the lake. A series of pools may become interconnected at periods of high water and form a link between this lake and a southern branch of the Amur's headwaters (Hailar Ho River).

The single Pacific basin locality visited during the course of this survey was along the Herelen Gol, about 60 km downstream of the main bridge in Kentei Aimak (see below). Several sites were extensively sampled and include the main river, many rivulets running across the marshy flood plain, and some isolated ponds (see p. 189 and Fig. 6). The main body of the river at this point is in excess of 50 m wide and was in spate following the heavy precipitation of the previous month.

The strong water current had disturbed the relatively high level of benthic debris and the water was turbid (Fig. 6). Young willow trees grow along the low muddy river banks and contribute allochthonously to the productivity of this stretch of the Herelen Gol; no other trees exist in this region. The flood plain on the west bank of the river is about 1 km wide and consists of a wide water meadow supporting, during the summer months, a large variety of grasses, flowering plants and insects. The many rivulets or streams that wind across these plains have a slow current of clear water and support a dense community of rooted macrophytes. Small isolated ponds (about 20 m in diameter with maximum depth of 2 m) occur along the streams and maintain a dense flora of aquatic macrophytes in their clear waters and peripheral clumps of reeds (Fig. 6).

Central Asian Internal Basin

The independent central Asian basin consists predominantly of large lentic water masses without outlets beyond this basin. They are fed by relatively short upland streams or rivers that drain the southern slopes of the Hangyin and northern slopes of the Mongolian Altai mountain ranges. Although these waters share a common fauna (see p. 193), geomorphologically the basin can be subdivided into the west Mongolian Great Lakes Valley and Gobi Valley Lakes (Dulma, 1979; Dgebuadze, 1986). The former includes several mountainous lakes and streams on the northern slopes of the Gobi Altai (e.g. Orog Nuur) and Hangyin Plateau. These ranges contain some of the highest mountain lakes in the country, with water levels varying in elevation from 759 m to 2232 m (Dulma, 1979: 714). All of these closed drainage systems eventually terminate in large endorheic lakes. The high concentration of dissolved salts (discussed below and see Table 1) often causes a white precipitate to occur around the lake margins. Some freshwater lakes are present (e.g. Archit Nuur in the Altai and Hungiiyn Har Nuur in the Hangyin mountains) but their outlet streams ultimately flow into an endorheic lake. The freshwater lakes are generally elongate and originated through karst formation. Despite the topographical distortions and rearrangements of the hydrographical network within the Central Asian basin, it retains a uniform fauna (Sokolov & Semyonova, 1986).

The principal localities sampled during the course of this survey in the Central Asian basin were Boon Tsagaan Nuur and its inflowing freshwater stream Tsagaan Gol, a tributary of Baydarag Gol (Fig. 7). In addition to this locality specimens were also obtained from Biger Nuur (discussed below). Both these lakes lie within the intermontane basin separating the Hangayn and Gobi Altai mountains which extends in an east–west direction for nearly 350 km (Fig. 2).

Boon Tsagaan Nuur is a deflation lake and typical of a series of permanent and seasonal endorheic lakes found in the western Gobi (Fig. 8 and see Davies, 1986). It has no outflow; several small streams and springs flow into the lake, the largest is Tsagaan Gol, an arm of Baydarag Gol which originates from the Hangyin highlands.

The presence of a series of ancient raised beaches clearly indicates that in the past this lake was of much larger proportions (Fig. 8); they were originally discussed by Andrews (1932: 300). To support a larger water mass, the carrying capacity of the inflowing river must have been far greater than the present Baydarag Gol system which is little more than a highland stream of clear, medium fast flowing water, with only dissolved sediments held in suspension. The eastern, isolated sub-basin of Boon Tsagaan Nuur (Fig. 8) does not appear to have any inflowing waters and is developing towards a dessicated salt-pan.

At present the shrinking of Boon Tsagaan Nuur, shown by the height and number of its raised beaches, appears to be in a continuing phase (this observation was supported by discussions with local inhabitants who described a lake of much larger proportions known to earlier generations).

Raised relict beaches are common around other basins in the Gobi Valley (e.g. Tsatsin Tsagaan Nuur, see Berkey & Morris, 1927: 247 & 392–3). Andrews (1932: 277) described '. . seven ancient beaches, high above the water level of 1922' off Tsatsin Tsagaan Nuur. The origin of the deflation basin that gave rise to the present lakes and the past higher water levels, led these authors to conclude that past climatic conditions must have been more arid or humid than at present. These unstable climatic fluctuations do not appear to have occurred gradually over a continuous period but in cycles or punctuated phases.

The salinity of the lake's water is not simply due to evaporation exceeding precipitation in this semi-desert region. The high concentration of dissolved ions in Boon Tsagaan

Fig. 6 Principal collecting locality Herelen Gol, 60 km downstream of bridge in Kentei Aimak, western bank. (Above opposite) Willow shoots along side channel, (Below opposite) main river in spate and (Above) isolated pond in flood plain.

Nuur is shown by the conductivity readings given below (p. 187).

In drying pools an evaporate is produced which can be several centimetres thick (Fig. 8), it supports a dense growth of salt tolerant *Salicornia*. Analyses of the evaporate revealed, not unexpectedly, a high concentration of calcium, magnesium, sodium and potassium; the concentrations of these and other elements in samples from two sites are summarised in Table 1. The high levels of these elements may be directly related to intense photosynthesis occurring in the lake (Goldman & Horne, 1983), the geological composition of its watershed and the absence of an outlet which will cause the lake to accumulate ions even if it is not contracting.

Table 1 Element concentrations (μg/g fresh weight) in salt samples from two sites around shore of isolated water body off Boon Tsagaan Nuur.

Element	Dist.H_2O	Sample 1	Sample 2
Al	.0234	.0568	.0225
B	.0062	1.2978	9.9068
Ca	.0209	41.4791	1.5461
Cd	.0027	.0029	.0021
Co	.0019	.0032	.0033
Cr	.0023	.0374	.0171
Cu	.0901	.0109	.0151
Fe	.0138	.0056	.0000
K	1.1680	10.1220	157.9320
Mg	.0087	62.3513	29.2913
Mn	.0004	.0032	.0019
Na	.1881	768.9119	786.2119
Ni	.0471	.0441	.0294
p	.0585	.7424	.3820
Pb	.0448	.0038	.0000
Si	.0073	.2946	.1956
Zn	.0152	.0116	.0070
Mo	.0261	.1197	.4533
Sr	.0000	2.2820	.6441
Ba	.0012	.0097	.0213

Elemental compositions were determined with an ICAP (inductively coupled argon plasma) spectrophotometer, using dilutions of atomic absorption stocks for standards.

Water clarity was low during August (see Secchi Disc readings given below p. 187). This is due to a massive algal and zooplankton bloom (autochthonous production). No macrophytes were observed along the wave washed littoral zone or even further offshore.

The water temperature of this holomictic lake was relatively high (see below) but dramatically dropped after a three day storm produced thorough mixing of the lake waters, which were otherwise prone to temporary thermal stratification. A massive development of zooplankton occurs in Boon Tsagaan Nuur during July and August (*pers. obs.* and Dulma, 1979: 728 gave average biomass as 2.1 g/m^3). The sandy substrate supports a rich fauna of zooplankton including rotifers, larval stoneflies (Plecoptera), dragonflies (Anisoptera) and caddis flies (Trichoptera).

Dulma (1979) classified the holo- and dimictic water bodies of the Gobi Valley as oligotrophic lakes. The productivity of saline lakes is often considered to be high (Goldman & Horne, 1983: 382), based on a few but nevertheless abundant species. The massive plankton bloom obtained during August, together with the high yield of fishes, suggests greater eutrophication than normally associated with oligotrophic systems. However, the sudden peak in productivity is short lived and must dramatically drop off to a much lower level during the

Fig. 7 Principal collecting localities; (Above) Boon Tsagaan Nuur, eastern shore with Altai mountains in distance and (Below) Tsagaan Gol, showing small inflowing tributary and outlet into lake.

severe winter months when between December and April the lake is frozen to a depth of 50–80 cm; this prevents mixing and thermal stratification must occur beneath the ice.

The low diversity of organisms in Boon Tsagaan Nuur makes it an ideal lake for productivity and food chain analyses.

Tsagaan Gol is a shallow stream (under 1 m) with a moderate current of clear, fresh water; its conductivity readings are given below (p. 187). The substrate consists of fine gravel with little interstitial benthic debris. However, a 2 cm mesh sized net strung across the stream soon became clogged with allochthonous plant debris which would normally be fed into the lake. Several small spring fed tributaries course across lake shore terraces to connect with Tsagaan Gol; rooted macrophytes and filamentous algae were common in these rivulets.

The width of the main stream is about 10 m, although it was several times this at its mouth into the lake (Fig. 7). On either side of Tsagaan Gol, around the north and eastern margin of the lake, are wide terraces covered in grasses and flowering plants. These are underlain by numerous freshwater springs as described around the shores of Kholoboldii Nuur by Andrews (1932: 288).

Biger Nuur and its inflowing stream Dzost Gol form an isolated basin draining the northern slopes of the Mongolian Altai mountains at the western end of the Gobi Valley, Yessen Aimak (Fig. 2). Although the basin was not visited, it is the locality of eight specimens donated to the author (see below). The biology of this remote lake remains poorly known.

The American Museum of Natural History Asiatic Expeditions passed the lake during a dry phase (Andrews, 1932: 301) and no description was given. The geomorphology, including geological and palaeontological data, was briefly reported by Razumowska (1946), Rozhdestvensky (1954) and Deryatkin & Liskim (1966). Subsequently, Gradzinski, Kazmierczak & Lefeld (1968) and most recently Russell & Zhai (1987) have discussed Biger Nuur. They described it as a salt lake occupying the central part of an intermontane basin between the Mongolian Altai Ridge and the granite massifs of Serkh Ula and Tayshiiven Ula. Apparently, salt marshes which periodically dry up occupy a large area around the lake.

COLLECTING LOCALITIES

Field work in Mongolia's three separate basins from the beginning of August to the end of the first week in September resulted in collections from 66 sites, designated: Net Stations (NS) 1–57, Rotenone Stations (RS) 1–7 and Fish Stations (FS) 1–2. A summary of the species and number of specimens caught is given in Table 2.

Two of these sites (FS 1–2) along the shores of Biger Nuur, Western Gobi, were not actually visited. Specimens from this lake were caught and presented to the author by Dr A. Dulma, Head of the Department of Zoology at the Institute of Biology in the Mongolian Academy of Sciences.

Net station. 1–4.

Date. 8 August 1984.

Geographical location. Main body of Tuul Gol, 5 km north of Lun, off main road after bridge west of the village, Central Aimak, MPR.

Table 2 List of species caught during 1984 survey.

	Number of specimens
Brachymystax lenok	14
Thymallus arcticus	16
Esox lucius	2
Rutilus rutilus	10
Leuciscus leuciscus baicalensis	36
Leuciscus idus	38
Leuciscus waleckii	2
Oreoleuciscus potanini 'Lake Form'	462
Oreoleuciscus potanini 'Dwarf Form'	8
Lagowskiella czekanowskii	249
Rhynchocypris steindachneri	3
Rhynchocypris costatus	3
Phoxinus phoxinus	213
Gobio gobio cynocephalus	11
Carassius auratus gibelio	34
Cyprinus carpio haematopterus	5
Noemacheilus barbatulus toni	64
Noemacheilus strauchi	80
Cobitis taenia	37
Misgurnus anguillicaudatus	41
Silurus asotus	1
Lota lota	4
Perca fluviatilis	115

Ecological notes. River about 50 m wide in broad river plain (Fig. 3) and swollen following heavy rains, with fast current over muddy bottom. Water turbid, brownish colour; temperature 22°C; conductivity 118.9μScm^{-1}.

Gear. Beach seine.

Catch: *Leuciscus idus* (27–143 mm).

Net station. 5–12.

Date. 9–11 August 1984.

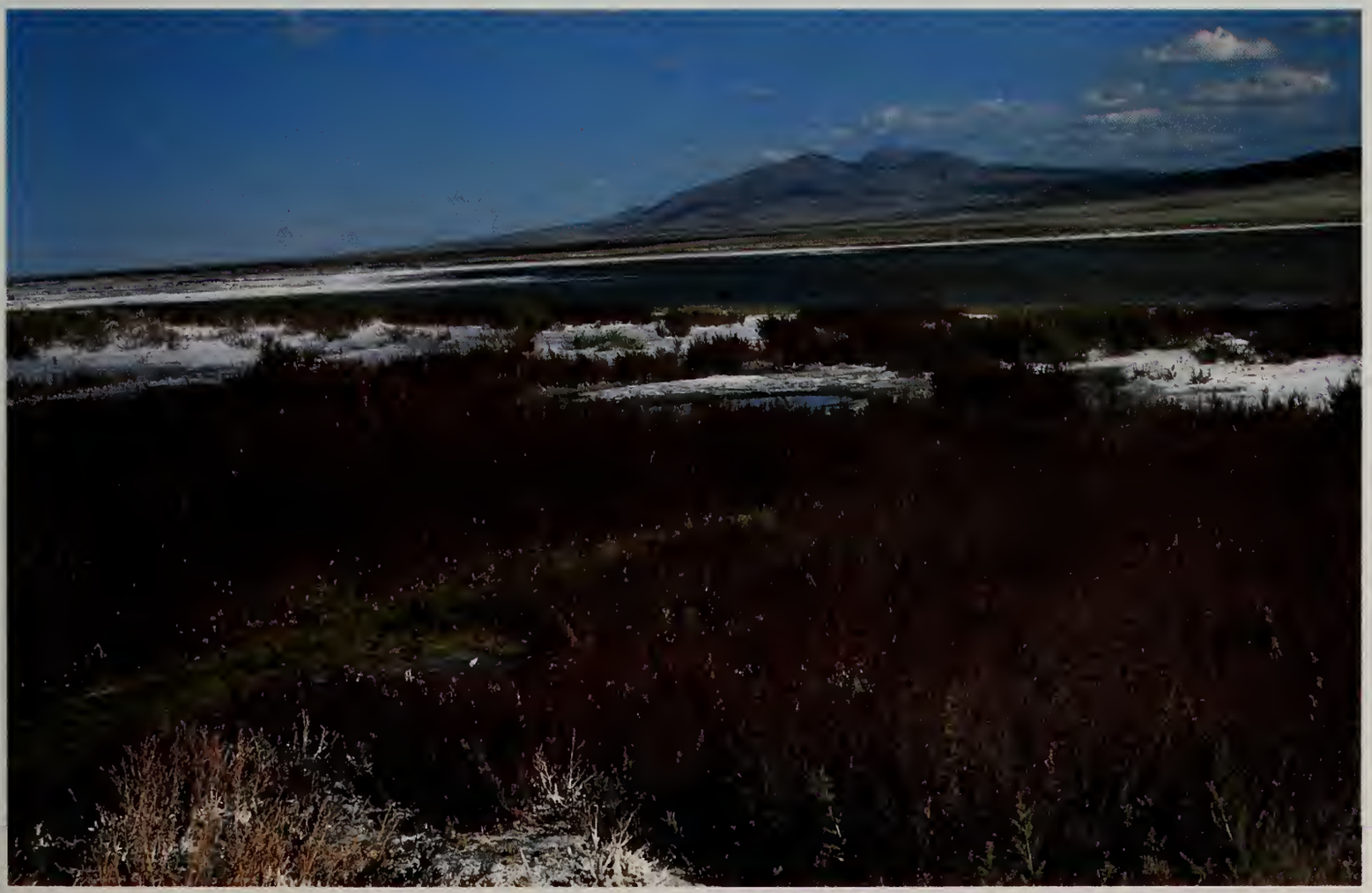
Geographical location. Northern shore of Ugiy Nuur, about 200 m off main track 1 km west from outlet into Orkhon Gol, Bulagan Aimak, MPR.

Ecological notes. Lake surrounded by rolling hills to the north and south, and extensive plains to the east and west. Narrow sandy-gravel, wave-washed beach, below steep grassy or eroded bank 1–2 m high (Fig. 5). Sandy-gravel substrate supports dense bank of rooted macrophytes in littoral zone extending about 20 m offshore to depth of 3 m. Clear, blue water with Secchi disc reading of 3 m above depth of 5 m; surface temperature 18.8°C; conductivity 323 and 321μScm^{-1}.

Gear. Sinking and floating gill nets set overnight for three nights, at distances between 30–200 m from shore, three beach seines from 40 m to shore (e.g. see Fig. 5) and fyke net set just beyond macrophyte bank.

Catch. Seven different species caught at this site. Gill nets yielded large *Perca fluviatilis* (222 mm & 310 mm), *Rutilus rutilus* (221–290 mm), *Leuciscus leuciscus baicalensis* (90–194 mm), *Leuciscus idus* (46–192 mm), *Esox lucius* (750 mm), *Silurus asotus* (665 mm) and *Carassius auratus gibelio* (306 mm). Each beach seine provided large numbers of juvenile *Perca* and *Leuciscus leuciscus baicalensis*. The fyke net remained empty although many medium sized *Leuciscus leuciscus baicalensis* (90–147 mm) were caught in the vertical

Fig. 8 Boon Tsagaan Nuur, western Gobi, Bayanhongar Aimak.
Top. Southern shore of lake viewed from above alluvial fans on foothills of Gobi Altai Mountains. East of lake, a salt pan indicates the existance of a larger water mass occuring during the recent history of the lake. A small water body is isolated between the salt pan and main body of the lake.



Bottom left. A series of relict shingle beaches appear as concentric rings along the lakes eastern shore and are evidence of its recent shrinkage; three white gurs (traditional Mongolian circular tents) can just be seen north of the lakes eastern margin and help give a scale of this vast open region of the Gobi.

Bottom right. East of the relict beaches, the small water body isolated from the main lake is surrounded by a white salty evaporate several centimetres thick and a red, salt tolerant plant (*Salicornia*).

leader net running into the mouth of the cage. Juvenile *Perca* and *Leuciscus leuciscus baicalensis* were directly observed (with the aid of mask and snorkel) feeding in the shallow littoral zone amongst the water plants (e.g. *Potamogeton* sp.).

Net station. 13–14.

Date. 12 August 1984.

Geographical location. Pebble shingle spit on south-eastern shore of Ugiy Nuur.

Ecological notes. Spit extends for about 200 m into lake, partly subdividing eastern basin from the main body of water. Pebble and coarse gravel substrate falls away as steep gradient from spit; no macrophytes. Clear, blue water; surface temperature 16.2°C; conductivity 323μScm^{-1}.

Gear. Gill nets set about 400 m into sub-basin overnight, and beach seine hauled off eastern and western side of pebble spit.

Catch. Only *Perca fluviatilis* (31–244 mm), *Leuciscus leuciscus baicalensis* (29–166 mm) and *L.idus* (186 mm) were caught; adults in gill nets and juveniles in beach seine.

Net station. 15–17.

Date. 13 August 1984.

Geographical location. Ugiy Nuur effluent, at south-eastern margin of lake.

Ecological notes. Detritus covered substrate supporting extremely dense growth of rooted macrophytes and reeds (Fig. 5). Slow current of clear water; surface temperature 17.0°C; conductivity 313μScm^{-1}.

Gear. Gill nets set at depth of 2–5 m, 200 m offshore and in effluent channel off weedy north bank shoreline amongst submerged vegetation.

Catch. Seven species, including *Rutilus rutilus* (188–233 mm), *Esox lucius* (head length 200 mm), *Leuciscus leuciscus baicalensis* (192 mm), *L.idus* (184 mm), *Carassius auratus gibelio* (290 mm), *Silurus asotus* (535 mm) and *Perca fluviatilis* (149 mm & 158 mm).

Net station. 18–19.

Date. 15 August 1984.

Geographical location. Orkhon Gol at Harhorim (Karakorum), 1 km upstream from bridge, South Khangai Aimak, MPR (Fig. 4).

Ecological notes. Crystal clear, fast flowing current over substrate of well rounded pebbles in riffles and fine detritus layer supporting short aquatic weeds in pools between riffle zones; water conductivity 129μScm^{-1}.

Gear. Beach seine hauled upstream (against current) for 40 m stretch of shallow pool between riffles, over pebble and weedy substrate; depth never exceeding half a metre. Shallow region along river bank sampled with hand-held dip net.

Catch. Seine yielded three juvenile *Thymallus arcticus* (60–73 mm) and numerous *Phoxinus phoxinus* (16–48 mm). *P.phoxinus* was also collected by hand-net, together with numerous small loaches, including *Cobitis taenia* (49–72 mm) and *Noemacheilus barbatulus toni* (30–40 mm).

Rotenone station. 1.

Date. 15 August 1984.

Geographical location. A small pool in flood plain on eastern side of Orkhon Gol, 1 km upstream from bridge at Harhorim.

Ecological notes. Pool 30 m long by 5 m wide with maximum depth of just over 1 m; supplied by small stream of water from main river which returns at the pool's broadest end back into the river. Slightly turbid water over sandy, muddy substrate that supports macrophytes and dense filamentous algae.

Gear. Rotenone applied at mouth of channel from main river and carried by current through pool before it was discharged down-stream into river.

Catch. Within about half an hour of rotenone application, the catch consisted of juvenile *Phoxinus phoxinus* (12–54 mm), *Noemacheilus barbatulus toni* (25–56 mm) and *Cobitis taenia* (20–58 mm).

Net station. 20–21.

Date. 16 August 1984.

Geographical location. Hogshin Orkhon Gol, a high gradient head-water of Orkhon Gol, about 60 km south from Harhorim along mountainous pass to Arvayheer, South Khangai Aimak, MPR.

Ecological notes. At the first station the stream courses across a high altitude alpine meadow and is about 1.5 m wide and 0.5 m deep, with a swift current of brown turbid water over a muddy substrate; slightly high river level was a result of recent rainstorm. The second station was close to the source of the river, at the head of the valley, and was made before starting the descent to Arvayheer. Here the stream is a few centimetres deep, about 0.5 m wide and runs over a substrate of coarse gravel and mud.

Gear. Hand-held net.

Catch. From the first station, consisted of *Cobitis taenia* (56 mm) and several *Noemacheilus barbatulus toni* (34–90 mm). The second station yielded only *N.barbatulus toni* (47–105 mm).

Net station. 22.

Date. 17 August 1984.

Geographical location. Spring fed freshwater stream meandering across water meadow about 40 m from eastern shore of Boon Tsagaan Nuur in valley of western Gobi, Bayanhongar Aimak, MPR.

Ecological notes. Slight current of pure, clear water several centimetres deep, above sandy/muddy substrate supporting a variety of aquatic plants.

Gear. Hand-held net.

Catch. Juvenile *Oreoleuciscus potanini* (16–38 mm)

Net station. 23–26.

Date. 18 August 1984.

Geographical location. Boon Tsagaan Nuur, an endorheic deflation lake about 45 km long by 20 km wide, in western Gobi Valley (Fig. 7).

ECOLOGICAL NOTES. Eastern shore of lake consists of typical low gradient sandy beach, no macrophyte growth. Water somewhat turbid due to prominent algal bloom and aggregated algal masses. Water temperature 17.2°C; Secchi disc reading 0.8 m at a depth of 2.2 m, 200 m off eastern shore; water conductivity 5892μScm^{-1}.

GEAR. Fleet of sinking and floating gill nets (mesh size 2–10 cm) employed over-night, 200 m offshore at depth of 2 m.

CATCH. Numerous *Oreoleuciscus potanini* ('Lake Form') only. Smallest mesh net (2 cm i.e. NS 23) caught fishes in size range between 89–150 mm; many between 100–150 mm SL were in a reproductively active state and readily shed gametes when handled. Medium mesh net (6 cm i.e. NS 24) caught fishes in size range between 150–300 mm SL, many shedding milt or spawn. Similar net set in lake opposite mouth of inflowing river, at depth of 1.1 m yielded a lighter catch of generally larger individuals (i.e. NS 25; 269–327 mm SL). Net with largest mesh size (10 cm) positioned opposite river mouth, yielded nothing.

NET STATION. 27–28.

DATE. 19 August 1984.

GEOGRAPHICAL LOCATION. Boon Tsagaan Nuur, 1–1.5 km off eastern shore.

ECOLOGICAL NOTES. Water temperature 21.2°C; conductivity 6160μScm^{-1} and 6379μScm^{-1} above depths of 4.5 m and 2.4 m respectively; Secchi disc 1.2m at both depths.

GEAR. Sinking gill nets, 6 & 10 cm mesh size, employed at depths of 4.5 m (NS 27) and 4.1 m (NS 28).

CATCH. Numerous *Oreoleuciscus potanini* (150–348 mm), many spawning, yielded by former (NS 27); the latter (NS 28) produced nothing.

NET STATION. 29–30.

DATE. 20 August 1984.

GEOGRAPHICAL LOCATION. Boon Tsagaan Nuur about 2 km off eastern shore.

ECOLOGICAL NOTES. Water temperature 21.6°C; conductivity 6270μScm^{-1}; Secchi disc 1.1 m above a total depth of 9.75m.

GEAR. Combined sinking and floating 6 cm mesh size gill nets.

CATCH. Heavy overnight storm, followed by violent winds which lasted for three days, made net retrieval impossible. After storm had dissipated, nets could not be located; water temperature 14.8°C and conductivity 5506μScm^{-1}.

NET STATION. 31.

DATE. 21 August 1984.

GEOGRAPHICAL LOCATION. Tsagaan Gol, tributary of Baydarag Gol, Western Gobi (Bayanhongar Aimak); about half a kilometre from mouth on north eastern shore of Boon Tsagaan Nuur (Fig. 7).

ECOLOGICAL NOTES. Crystal clear swift current of fresh water 20 m wide with maximum depth of 1 m over a substrate of fine gravel with no sign of macrophytes; conducticity 244μScm^{-1}.

GEAR. Gill net, 4cm mesh size, strung between banks overnight.

CATCH. Nothing.

ROTENONE STATION. 2.

DATE. 22 August 1984.

GEOGRAPHICAL LOCATION. Small tributary of Tsagaan Gol, supplied by spring emanating from meadow bordering Boon Tsagaan Nuur.

ECOLOGICAL NOTES. Crystal clear current of fresh water over a substrate of fine gravel. 1–4 m wide with a maximum depth of half a metre; conductivity 193μScm^{-1}.

GEAR. Rotenone applied to small blind inlet of tributary with slow moving current and some algae and small rooted aquatic plants.

CATCH. Large numbers of juvenile *Oreoleuciscus potanini* (10–86 mm) and two juvenile *Noemacheilus strauchi* (30 & 26 mm).

ROTENONE STATION. 3.

DATE. 22 August 1984.

GEOGRAPHICAL LOCATION. Small isolated pool in river channel on eastern side of main course of Tsagaan Gol, about half kilometre from mouth into Boon Tsagaan Nuur. (Fig. 7).

ECOLOGICAL NOTES. Still, murky water supporting algae and some small rooted aquatic plants.

GEAR. Rotenone applied at several points along pool.

CATCH. Numerous juvenile *Oreoleuciscus potanini* (10–37 mm).

ROTENONE STATION. 4.

DATE. 22 August 1984.

GEOGRAPHICAL LOCATION. Narrow channel on western side of Tsagaan Gol, about half kilometre from its mouth into Boon Tsagaan Nuur.

ECOLOGICAL NOTES. Channel 30 m long, 6 m wide, with maximum depth of 2 m. Closed at north end with freshwater emanating from spring and passing along channel to southern end and open connection with Tsagaan Gol. Murky water supports algae and other aquatic plants.

GEAR. Rotenone applied to north end of channel and carried by current to its mouth.

CATCH. Numerous juvenile *Oreoleuciscus potanini* (10–40 mm) and *Noemacheilus strauchi* (39–66 mm).

ROTENONE STATION. 5.

DATE. 26 August 1984.

GEOGRAPHICAL LOCATION. Pool in water meadow off north bank of Tamir Gol, 2–3 km upstream from confluence with upper reaches of Orkhon Gol, adjacent to Ugiy Nuur, North Khangai Aimak, MPR.

ECOLOGICAL NOTES. Crystal clear water to about 1 m depth in 6 m wide pool containing dense aquatic plants (e.g. *Potamogeton* sp.).

GEAR. Rotenone.

CATCH. Nothing.

NET STATION. 32–36.

DATE. 26 August 1984.

GEOGRAPHICAL LOCATION. North bank of Tamir Gol, 2–3km upstream from confluence with upper reaches of Orkhon Gol, adjacent to Ugiy Nuur.

ECOLOGICAL NOTES. River in spate following heavy rains, extremely swift, strong current of brown turbid water (Fig. 3). Numerous small streams course across quite densely vegetated bank to supply small pools in wide flood plain; willow stands common along bank.

GEAR. Seine net dredged against current along stretch of stream in flood plain and hand-held dip net dragged through water along bank of main river and small inflowing stream.

CATCH. *Brachymystax lenok* (106 & 165 mm), *Thymallus arcticus* (51–74 mm), *Leuciscus leuciscus baicalensis* (162 mm), *Phoxinus phoxinus* (2–54 mm), *Noemacheilus barbatulus toni* (30–62 mm) and *Cobitis taenia* (53–73 mm).

NET STATION. 37–40.

DATE. 29–30 August 1984.

GEOGRAPHICAL LOCATION. Inlet along west bank of Terilg Gol, at end of vehicle track just east of recreation centre 35 km east of Ulan Bator, Central Aimak, MPR (Fig. 4).

ECOLOGICAL NOTES. High gradient riffles of fast clear water over pebble and rock substrate. Inlet separated from main river by pebble bar lined with willow shoots; main river bank generally low and tree lined, with young pine and birch. Inlet channel 35 m long, 8 m wide and not more than 1.5 m deep, contained murky water and some aquatic plants.

GEAR. Four night hauls up channel with seine, letting it extend into main river before hauling to blind end of inlet. Gill net (4 cm mesh) suspended between pebble bar and bank overnight.

CATCH. *Brachymystax lenok* (53–408 mm), *Thymallus arcticus* (148–251 mm), *Leuciscus leuciscus baicalensis* (260 mm), *Noemacheilus barbatulus toni* (100 m) and *Lota lota* (376 mm).

NET STATION. 41–42.

DATE. 31 August 1984.

GEOGRAPHICAL LOCATION. Terilg Gol inlet and pool at end of vehicle track beyond recreation centre, 35 km east of Ulan Bator.

ECOLOGICAL NOTES. Pool was 3–4 m deep with slow current of murky water over submerged vegetation which was particularly dense in sheltered region below a 20 m high rocky embankment covered in young willow and birch saplings.

GEAR. Sinking gill nets (4 cm) set overnight across inlet and pool.

CATCH. Nothing caught from inlet, water level had dropped since arrival at this locality and channel quite shallow compared to two previous nights. Catch from pool consisted of *Thymallus arcticus* (183–219 mm) and *Lota lota* (257–289 mm).

NET STATION. 43

DATE. 1 September 1984.

GEOGRAPHICAL LOCATION. Stream meandering across flood plain off western bank of Herelen Gol, about 60 km downstream from main bridge in Kentei Aimak, MPR.

ECOLOGICAL NOTES. Stream about 12 m wide and depth not exceeding 2 m, had a moderate current of murky water over a muddy substrate.

GEAR. Hand-held net.

CATCH. *Lagowskiella czekanowskii* (16–48 mm), *Rhynchocypris costatus* juvenile (43 mm), *Phoxinus phoxinus* (21 & 50 mm), *Gobio gobio cynocephalus* (21 & 22 mm), *Cobitis taenia* (52–79 mm) and *Misgurnus anguillicaudatus* (20–81 mm).

NET STATION. 44–45.

DATE. 1 September 1984.

GEOGRAPHICAL LOCATION. West bank of Herelen Gol, about 60 km downstream of the main bridge, Kentei Aimak.

ECOLOGICAL NOTES. At this point, river runs beneath a high eastern escarpment face (Fig. 6) and has a width of 50–100 m as it cuts through a terraced flood plain of 2–3 km in width. Rich variety of flowering plants cover the flood plain and attract butterflies and other flying insects. River in spate following heavy rains, bank not clearly visible (Fig. 6).

GEAR. Beach seine hauled across two flooded water meadows adjacent to main, fast flowing river.

CATCH. *Leuciscus leuciscus baicalensis* (190 mm; cf *brevirostris* Mori, 1938).

NET STATION. 46–47.

DATE. 1 September 1984.

GEOGRAPHICAL LOCATION. Main stream of Herelen Gol, west bank, 60 km downstream from bridge, Kentei Aimak.

ECOLOGICAL NOTES. Powerful current of brown turbid water over a muddy substrate; region fished sheltered from main force of current by willow stand (Fig. 6).

GEAR. Seine net dropped from dinghy 20 m off bank.

CATCH. Nothing.

NET STATION. 48–49.

DATE. 2 September 1984.

GEOGRAPHICAL LOCATION. Side channel off west bank of Herelen Gol, 60 km downstream from bridge, Kentei Aimak.

ECOLOGICAL NOTES. Channel divided from main river by pebble and mud bank supporting Willow shoots. Swift current of brown, murky water not with force found in main stream and decreasing in strength from previous day.

GEAR. Sinking gill nets (2 & 4 cm mesh) secured to willow shoot and allowed to be taken with current, left overnight.

CATCH. *Brachymystax lenok* (196–315 mm).

Net Station. 50.

Date. 2 September 1984.

Geographical location. Rivulet half a kilometre east of western bank of Herelen Gol, 60 km downstream from bridge, Kentei Aimak.

Ecological notes. Slow current of clear water, 10–20 m wide and several metres deep above a muddy substrate supporting dense growth of aquatic plants. Rivulet expands into pool along its course, macrophytes and reeds numerous.

Gear. Seine hauled across pool in evening.

Catch. Nothing; this could have been partly due to vegetation hindering net.

Net Station. 51–53.

Date. 3 September 1984.

Geographical location. Side channel and main stream of Herelen Gol, 60 km downstream from bridge, Kentei Aimak.

Ecological notes. Brown, turbid water continuing to drop in level compared to previous days; current in main stream still powerful.

Gear. Sinking gill nets (2 & 4 cm mesh) set in 1–2 m of water, secured to willow stands and left overnight.

Catch. Net in main stream (i.e. NS 51) empty, those in side channel caught *Brachymystax lenok* (400 mm), *Rhynchocypris steindachneri* (110 mm), *Rhynchocypris costatus* (160 mm) and two juvenile *Carassius auratus gibelio* (89 & 91 mm).

Net Station. 54–56.

Date. 4 September 1984.

Geographical location. Side channel off main stream of Herelen Gol, 60 km downstream from road bridge, Kentei Aimak.

Ecological notes. Brown, turbid water with relatively swift current; water level lower than at previous days.

Gear. Hand-held net hauled along shallow water off west bank and sinking gill nets (2 & 4 cm mesh) secured to willow stands and left to drift into main stream by powerful current (Fig. 6).

Catch. *Rhynchocypris steindachneri* (136 mm), *Phoxinus phoxinus* (37–43 mm), *Gobio gobio cynocephalus* (110 mm), *Carassius auratus gibelio* (90 mm), *Noemacheilus barbatulus toni* (juvenile, 29 mm), *Cobitis taenia* (60 mm) and *Lota lota* (180mm).

Net Station. 57.

Date. 4–5 September 1984.

Geographical location. Pool along rivulet in water meadow about half a kilometre from main stream Herelen Gol, 60 km down-stream from bridge, Kentei Aimak.

Ecological notes. Pool supports dense growth of macrophytes and reeds.

Gear. Sinking gill net (3 cm mesh) left for two consecutive nights.

Catch. *Rutilus rutilus* (371 mm), *Rhynchocypris steindachneri* (115 mm) and several juvenile *Carassius auratus gibelio* (87–95 mm).

Rotenone Station. 6.

Date. 5 September 1984.

Geographical location. Pool along rivulet in water meadow described for NS 50 & 57.

Ecological notes. Eastern region of deep, permanent pool of clear water with slow current over dense aquatic vegetation (see NS 50 & 57 above).

Gear. Rotenone.

Catch. Nothing apart from some water snails.

Rotenone Station. 7.

Date. 5 September 1984.

Geographical location. Isolated pond in water meadow, about half a kilometre from west bank of Herelen Gol and close to rivulet (NS 50 & 57) draining flood plain.

Ecological notes. At times of high water, pond may temporarily be joined to rivulet (Fig. 6). Pond appears to be permanent and supports partly submerged reeds around its perimeter and dense growth of fully submerged rooted macrophytes which were clearly observed through the clear water.

Gear. Rotenone applied evenly around pond.

Catch. *Lagowskiella czekanowskii* (20–60 mm), *Rhynchocypris costatus* (40 mm), *Phoxinus phoxinus* (36 mm), *Gobio gobio cynocephalus* (20–60 mm), *Carassius auratus gibelio* (30–55 mm) and *Misgurnus anguillicaudatus* (36 mm).

SYSTEMATIC ACCOUNT

This account deals only with the specimens obtained during the 1984 ichthyological survey in the Mongolian People's Republic.

Twenty-two species of primary freshwater fishes, representing eight families, are detailed in systematic order. The specimens have been incorporated into the collections of the British Museum (Natural History); abbreviated as BM(NH). Net or rotenone station, register number and standard length are given for all specimens.

Initial identifications were made using standard works on the fishes of the USSR (Berg, 1948), Mongolian People's Republic (Shatunovskii, 1983 & 1985) and People's Republic of China (Nichols, 1943). Many taxonomic problems associated with the fishes from these regions were revealed which required reference to specialist literature. Where a taxon has been recently revised by a specialist of the group (e.g. Holčík & Skořepa, 1971 for *Rutilus*, or Howes, 1985 for *Phoxinus*), attention was given to their taxonomic proposals.

Where necessary, the specialist literature was supplemented by comparison with type and other material held at the BMNH and Museum National d'Histoire Naturelle, Paris (MNHN) or obtained on loan from the American Museum of Natural History (AMNH). Intraspecific variation, geographical range, ecological notes and a taxonomic discussion are given for each species.

Fig. 9 *Brachymystax lenok* in lateral view (237 mm SL; BMNH 1986.8.28: 3–5).

Fig. 10 *Thymallus arcticus*, lateral view (165 mm SL; BMNH 1986.8.28: 27–28)

SALMONIDAE
SALMONINAE

Brachymystax lenok (Pallas, 1773)

Fig. 9

MATERIAL. NS 36, 1986.8.28: 1–2 (106 & 165 mm); NS 37, 1986.8.28: 3–5 (226–237 mm); NS 37, 1986.8.28: 6 (408 mm)) NS 38, 1986.8.28: 7–8 (236–247 mm); NS 40, 1986.8.28: 9 (53 mm); NS 48, 1986.8.28: 10–11 (236 & 315 mm); NS 49, 1986.8.28: 12–13 (196 & 248 mm); NS 52, 1986.8.28: 14 (400 mm). Total 14 specimens.

VARIATION. Morphometric diagnosis of this monotypic genus given by Berg (1948), Holčík & Pivnička (1968: 4) and Shatunovskii (1983 & 1985 see figs. 2 & 3). A prominently pink coloured ventral region present in my specimens was not mentioned in Berg's colour description (1948: 320); maybe it is coloration associated with the breeding cycle.

GEOGRAPHICAL RANGE. Extends from the Ob River in western Siberia, east to the Amur River and its tributaries in the USSR and North China.

ECOLOGICAL NOTES. In Mongolia collected from the main stream and side channels of the Terilg Gol (Arctic basin) and Herelen Gol (Pacific basin); a distribution that supports that proposed by Shatunovskii (1983: 114).

TAXONOMIC DISCUSSION. A *Brachymystax* species was reported by Mori (1938 and see Berg, 1948: 318) from the Upper Yalu River. I suspect this species in which '... the snout is strongly elongated forming a fleshy cone projecting forward above the lower jaw' (Berg, 1948: 318) is a *Rhynchocypris* (sensu Howes, 1985; see below p. 197) and is not referrable to *Brachymystax lenok*.

The Upper Yalu River forms the natural border between North Korea and China (PRC) and may, historically, or even seasonally, be connected with the Amur River system by southern tributaries of the Sungari River. *Brachymystax* was caught together with *Rhynchocypris* during the course of this survey in the Herelen Gol, a Mongolian headwater of the Amur River.

THYMALLINAE

Thymallus arcticus (Pallas, 1776)

Fig. 10

MATERIAL. NS 19, 1986.8.28: 15–17 (60–73 mm); NS 32, 1986.8.28: 18–21 (51–74 mm); NS 37, 1986.8.28: 22–26 (148–

Fig. 11 *Rutilus rutilus*, lateral view (271 mm SL; BMNH 1986.8.28: 33–35).

251 mm); NS 38, 1986.8.28: 27–28 (165–192 mm); NS 41, 1986.8.28: 29–30 (183–219 mm). Total 16 specimens.

VARIATION. Agree with description given by Berg (1948: 449), Holčík & Pivnička (1968: 4) and Shatunovskii (1983: 127 and 1985: 56).

GEOGRAPHICAL RANGE. Has a holarctic distribution (Scott & Crossman, 1973) which extends south in Asia to northern Mongolia and the Upper Yalu River.

ECOLOGICAL NOTES. Within Mongolia is confined to waters of the Arctic basin and was caught in the main stream and inlets of the Orkhon, Tamir and Terilg Gols.

TAXONOMIC DISCUSSION. Distinct subspecies are recognised in other regions of Mongolia including, in Pacific draining headwaters of the Amur River system, the subspecies *Thymallus arcticus grubei* (Berg, 1948; Shatunovskii, 1983) and, in Khobsogul Nuur, the lacustrine subspecies *Thymallus arcticus nigrescens* (Scott & Crossman, 1973). In addition to these, attention should be given to a single specimen described by Boulenger (1898) as *Phylogephyra altaica*, a monotypic genus '... from the south side of the Altai Mountains ... brought home by Mr St. George Littledale'.

Boulenger (1898) believed this species '... completely bridges over the gap' between the two groups designated at that time as Salmoninae and Coregoninae and '... approaches the genus *Thymallus*'; in particular *T.brevirostris*. Berg (1909) synonymised *P.altaica* with *T.brevirostris* and most subsequent authors have followed his decision (e.g. Svetovidov, 1936; Shatunovskii, 1983 & 1985), even though *T.brevirostris* is confined to the western Mongolian Great Lakes basin while the type locality of *altaica* lies outside this enclosed system.

As part of a systematic study of the Salmonidae, Benke (1965: 234) examined the holotype of *Phylogephyra altaica* and concluded the genus should be retained. I support his view that *altaica* represents a distinct thymalline species. Although the type is in a poor state, it represents a taxon quite distinct from other *Thymallus* species in several characters (e.g. head length; jaw cleft position posterior to eye; large, strong caniniform teeth on jaws, vomer and palatines; 12 pelvic fin rays; only 7–8 scales dorsal to the lateral line).

Whether these differences merit *altaica* being placed in a distinct genus (i.e. *Phylogephyra*, as proposed by Boulenger, 1898) must await a further analysis of thymalline interspecific relationships. For the present, *altaica* must be removed from the synonymy *T.brevirostris*, be recognised as a distinct species of *Thymallus* and be considered as an additional member of the Mongolian fish fauna.

ESOCIDAE

Esox lucius Linnaeus, 1758

MATERIAL. NS 9, 1986.8.28: 31 (246 mm head length, to posterior edge of operculum); NS 16, 1986.8.28: 32 (200 mm head length, to posterior edge of operculum). Total 2 specimens (both incomplete; head with pectoral girdle attached and caudal fin).

VARIATION. Agree with the diagnosis given by Berg (1948) and Shatunovskii (1983: 133) who based his description on 50 specimens from the same lake (Ugiy Nuur).

GEOGRAPHICAL RANGE. Widespread across freshwaters of Eurasia from the British Isles and western Europe to the headwaters of Arctic draining systems of eastern USSR.

ECOLOGICAL NOTES. This is the only species of pike present in Mongolian Arctic basin waters and was caught during this survey in Ugiy Nuur. In both cases the fishes appeared to be attracted to gill nets of small mesh size (i.e. 2 & 3 cm) by the presence of suitable prey (e.g. *Leuciscus idus*) caught in the nets. In an attempt to engulf prey, *E.lucius* became caught by twine looped around its large caniniform teeth.

TAXONOMIC DISCUSSION. A second species, *Esox reicherti*, is endemic to the Amur basin (Shatunovskii, 1983; Scott & Crossman, 1973: 357) and is considered to be part of the Mongolian fauna. However, it was not caught from localities sampled during the course of this survey.

CYPRINIDAE

Rutilus rutilus (Linnaeus, 1758)

Fig. 11

Fig. 12 *Leuciscus leuciscus baicalensis*, lateral view (192 mm SL: BMNH 1986.8.28: 77).

MATERIAL. NS 5 & 6, 1986.8.28: 33–35 (271–290 mm); NS 9, 1986.8.28: 36 (221 mm); NS 10 & 11, 1986.8.28: 37–40 (230–243 mm); NS 16, 1986.8.28: 41–42 (188–223 mm). Total 11 specimens.

VARIATION. Agree with the diagnosis given by Berg (1948: 499) and more recently by Shatunovskii (1983: 40) for the subspecies *R.rutilus lacustris*.

GEOGRAPHICAL RANGE. Has a typical Eurasian distribution extending from England in the west to the Lena River in the east, and from the Ob River in the north to the watershed of the Caspian and Aral seas in the south.

ECOLOGICAL NOTES. Within Mongolia *R.rutilus* is confined to Arctic draining waters and was caught in abundance in Ugiy Nuur. It is not surprising, therefore, that these specimens coincide closely with the diagnosis given by Shatunovskii (1983) as it was based on 31 specimens from the same lake. The length of the largest specimen caught during this survey (290 mm) exceeds that recorded by Berg (1948), Holčík & Skořepa (1971) or Shatunovskii (1983).

The diet of *R.rutilus* is varied (Wheeler, 1969: 207) and consists as much of plant material (e.g. diatoms, filamentous algae and macrophytes) as animal foods (e.g. planktonic larvae, insects, freshwater shrimps, aquatic isopods and molluscs). Analysis of gut contents of Ugiy Nuur specimens revealed, in general, remains of plant, insect and mollusc material.

TAXONOMIC DISCUSSION. The degree of overlap between meristic and morphometric subspecific characters described by Berg (1948) indicates the possibility of clinal variation. Holčík and Skořepa (1971) revised the taxonomy of the species, using comparative series of specimens from populations covering the whole area of distribution. They concluded that '... *Rutilus rutilus* exhibits only relatively minor variation in morphological features' to the extent that it '... has not yet evolved such distinct morphological and biological populations that the term subspecies can be applied'.

Surprisingly, the most recent texts on the fishes of Mongolia (Shatunovskii, 1983 & 1985) make no reference to the revision by Holčík & Skořepa (1971). For the present, the Mongolian representatives of this genus should be referred to the nominate form.

Leuciscus leuciscus baicalensis (Dybowskii, 1874)

Fig. 12

MATERIAL. NS 5 & 6, 1986.8.28: 44–48 (136–194 mm); NS 9, 1986.8.28: 49 (166 mm); NS 10 & 11, 1986.8.28: 50–70 (90–147 mm); NS 13, 1986.8.28: 71–75 (29–33 mm); NS 14, 1986.8.28: 76 (166 mm); NS 16, 1986.8.28: 77 (192 mm); NS 36, 1986.8.28: 78 (162 mm); NS 37, 1986. 8.28: 79 (260 mm). Total 36 specimens.

VARIATION. Lie within the range of meristic characters given by Berg (1948: 77), Holčík & Pivnička (1968: 5) and Shatunovskii (1983: 142).

GEOGRAPHICAL RANGE. Restricted to waters of the Arctic basin in Siberia, from the Ob River eastwards to the Kolyma; from their highland headwaters to river mouths.

ECOLOGICAL NOTES. Within Mongolia this subspecies is recorded from two rivers in the Arctic basin (Selenga and Shishkid Gols; Shatunovskii, 1983: 143). In addition to these rivers it was also found in the Tamir and Terilg Gol and Ugiy Nuur (see also Dulma, 1979) during the course of this survey.

TAXONOMIC DISCUSSION. The Siberian fauna of *Leuciscus leuciscus* appears to be distinct from other holarctic populations and was recognised subspecifically by Berg (1948) as *L.leuciscus baicalensis*.

Leuciscus idus (Linnaeus, 1758)

Fig. 13

MATERIAL. NS 1–4, 1986.8.28: 81–104 (27–143 mm); NS 5–6, 1986.8.28: 105–107 (126–192); NS 7, 1986.8.28: 108–112 (46–83 mm); NS 9, 1986.8.28: 113 (173 mm); NS 10–11, 1986.8.28 :114–116 (94–120 mm); NS 14, 1986.8.28: 117 (186 mm); NS 16, 1986.8.28: 118 (184 mm). Total 38 specimens.

VARIATION. Lie within the range of meristic characters for this species described by Berg (1948: 97) and Shatunovskii (1983: 144).

GEOGRAPHICAL RANGE. Can be considered to have a Eurasian distribution, occurring in Europe from the Rhine and probably the Somme, east-wards to the Siberian Arctic basin as far as the Lena River.

Fig. 13 *Leuciscus idus*, lateral view (192 mm SL: BMNH 1986.8.28: 105–107).

ECOLOGICAL NOTES. In Mongolia this species is recorded from waters of the Selenga River basin and was found during this survey in the Tuul Gol and Ugiy Nuur.

TAXONOMIC DISCUSSION. *Leuciscus idus* is distinguished from other Mongolian members of the genus by a greater number of lateral line scales (56–61) and gill rakers (10–14).

Leuciscus waleckii (Dybowskii, 1869)

MATERIAL. NS 57; 1986.8.28: 43 (371 mm); NS 44, 1986.8.28: 80 (190 mm). Total 2 specimens.

VARIATION. Conform to the description supplied by Berg (1949: 102), Holčík & Pivnička (1968: 5) and Shatunovskii (1983: 145; largely taken from Nicholski, 1956: 116).

GEOGRAPHICAL RANGE. Distributed within the entire basin of the Amur River system, from upper Mongolian headwaters to the Yalu, Ussuri and Sangari Rivers in eastern China; recorded by Berg (1948: 102) as 'Quite common everywhere . . ' in these waters.

ECOLOGICAL NOTES. Within Mongolia *Leuciscus waleckii* is found in rivers and lakes of the Pacific basin and was caught at localities sampled along the Herelen Gol.

TAXONOMIC DISCUSSION. Many meristic characters overlap with those from other *Leuciscus* species, separation may be more easily determined using morphometric data and its alleged endemicity to waters of the Amur basin in Eastern Asia. Live coloration is markedly similar to that of the Siberian roach (*Rutilus rutilus*) with which it can be easily confused.

The large specimen caught during the course of this survey is of a size rarely encountered (Berg, 1948: 102), and has a greater total length than has been previously recorded for the species.

Hitherto, the species was only represented in the collections at the BMNH by a single small specimen collected by V.Brashninov in 1902 and sent as a gift from the museum in Leningrad (BMNH 1925.8.6: 27; previously Leningrad Museum Cat. No. 13851).

Oreoleuciscus potanini Kessler, 1879
'Lake Form'

Fig. 14

MATERIAL. NS 22, 1986.8.28: 119–127 (20–30 mm); NS 22, 1986.8.28: 128–140 (16–38 mm); NS 23 & 24; 1986.8.28: 141–152 (115–214 mm); NS 23–24, 1986.8.28: 153–171 (89–213 mm); NS 25–26, 1986.8.28: 172–186 (150–300 mm); NS 25–26, 1986.8.28: 187–192 (269–327 mm); NS 27, 1986.8.28: 193–197 (289–348 mm); RS 2, 1986.8.28: 198–200 (53–86 mm); RS 2, 1986.8.28: 201–247 (10–31 mm); RS 2, 1986.8.28: 248–337 (10–45 mm); RS 2, 1986.8.28: 338–483 (10–37 mm); RS 3–4, 1986.8.28: 484–518 (10–37 mm); RS 3–4, 1986.8.28: 519–581 (12–35 mm). Total 463 specimens.

VARIATION. Analysis of this material using the diagnosis for three *Oreoleuciscus* species recognised by Berg (1948: 67) and, more recently, Dashdorzh, Dulma and Pivnička (1969) does not lead to a satisfactory allocation of the specimens to any one species. The more recent analyses of Borisovets, Dgebuadze and Ermokhin (1984 & 1985) and Shatunovskii (1985) is adopted here. These authors recognise only a single species, *Oreoleuciscus potanini*, but describe several distinct 'forms'.

GEOGRAPHICAL RANGE. *Oreoleuciscus* is endemic to the Central Asian or enclosed Internal basin of Mongolia (Vasil'eva, 1985: fig. 1), with only a small number recorded from the USSR in the upper reaches of the Ob River (Shatunovskii, 1983: 155).

ECOLOGICAL NOTES. During the course of this survey, the two localities sampled were the saline lake Boon Tsagaan Nuur and its inflowing freshwater stream Tsagaan Gol (see above, p. 187). Individuals ranging in size from small fry to large mature adults were caught; among them is the largest size recorded for this species (i.e. 348 mm). The lake appeared to support a dense *Oreoleuciscus* population but no other species of fish. Reproductively active males and females, readily shedding their gametes, were taken from several hundred metres off-shore (see p. 187) and contradict the view of Dulma (1979: 726) that these fishes return to freshwater streams and rivers to spawn. Breeding fishes were vividly

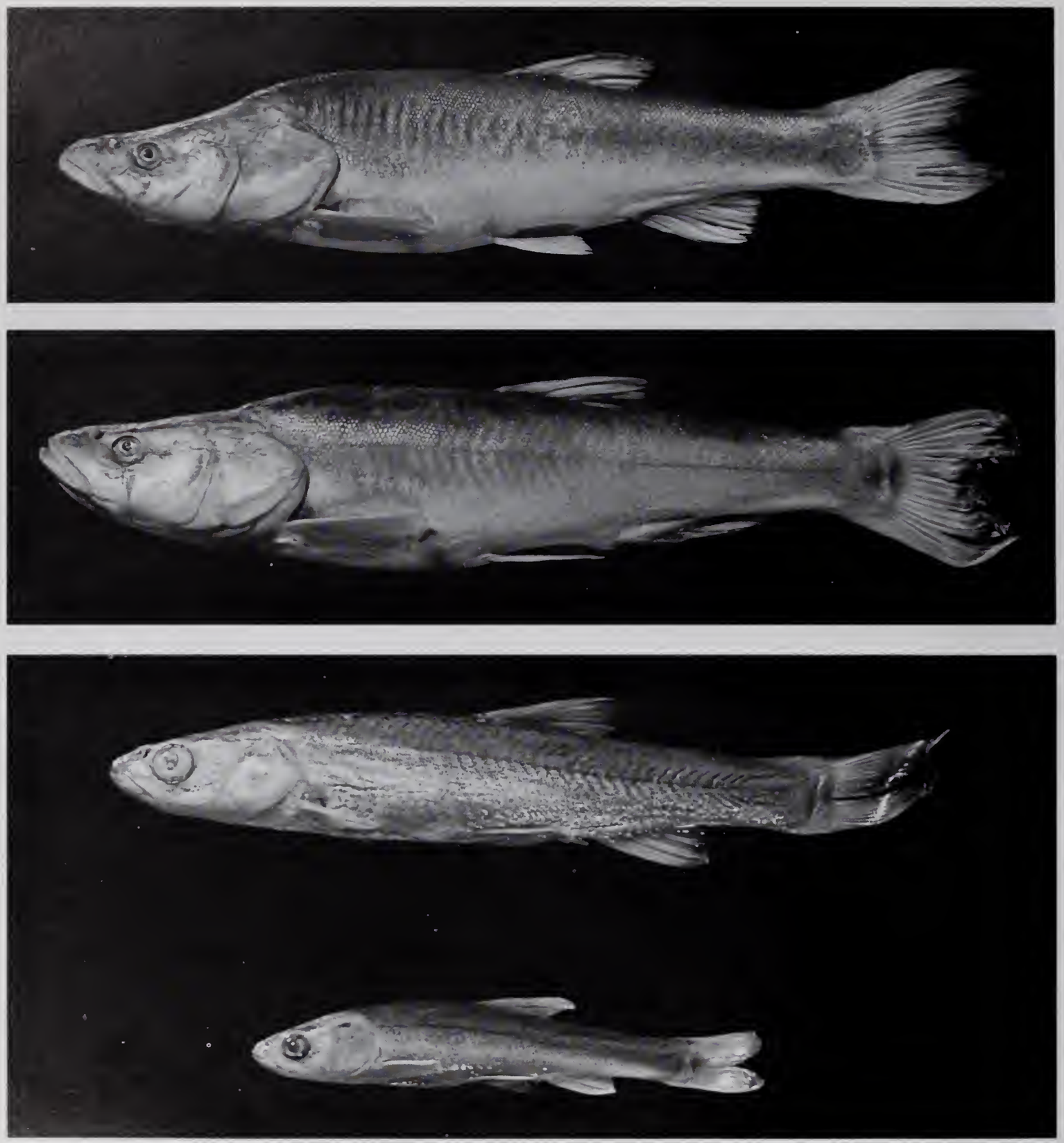


Fig. 14 *Oreoleuciscus potanini* 'Lake Form', lateral view of (Top) gravid female (317 mm SL; BMNH 1986.8.28: 187–192), (Middle) spawning male (300 mm SL; BMNH 1986.8.28: 172–186) and (Bottom) riverine juveniles (86 & 53 mm SL; BMNH 1986.8.28: 198–200).

coloured with a pearly rash on their head (Davies, 1986). Sexually dimorphic females were distinguished by taut abdominal musculature outlining each pair of pleural ribs, hypertrophy of epaxial muscles posterior to the neurocranium, generally elongated snouts and concave dorsal surface of the head. A surprisingly large size range of spawning individuals was collected (e.g. 80–348 mm) and gut contents revealed plant (e.g. algae) and animal (e.g. insect larvae, oligochaetes and smaller individuals of their own species) remains, depending on the fishes' stage of development (see Shatunovskii, 1985: 48).

TAXONOMIC DISCUSSION. The specimens appear to exhibit a combination of many specific characters discussed by Dashdorzh *et al.* (1969). Extensive interspecific variability has led many authors to reassess the composition of the genus. Most recent opinions can generally be divided between the recognition of two closely related but nevertheless distinct

Fig. 15 *Oreoleuciscus potanini* 'Dwarf Form', lateral view (65 & 52 mm SL; BMNH 1986.8.28: 1048–1053).

species (i.e. *Oreoleuciscus potanini* and *Oreoleusicus pewzowi*: Vasil'eva, 1982 & 1985; with judgement being reserved until further analysis of the possibility of a third i.e. *Oreoleuciscus humilis*: after Berg, 1948 and Dashadorzh *et al.*, 1969), or a single polymorphic species (i.e. *Oreoleuciscus potanini*: Jorgansen, 1940; Kafanova, 1961; Svetovidova, 1965; Gundrizer, 1976; Dgebuadze & Ryadov, 1978; Dgebuadze, Ermuhin, Lapin, Ryabov & Trophimenko, 1979; Borisovets *et al.*, 1984 & 1985; Shatunovskii, 1983 & 1985).

'Ichthyophagous', 'phytophagous', 'sharp-snouted' and 'dwarf forms' of the polymorphic *Oreoleuciscus potanini* were described by Shatunovskii (1983), who considered them to occur throughout the water bodies of the Central Asian basin. Borisovets *et al.* (1985) added a 'lake form'. It is confined, together with the 'dwarf form', to the isolated water bodies of the Gobi Valley (i.e. Dolin and Hangiyn systems, see Dgebuadze, 1986, and above), whilst the other forms (i.e. 'ichthyophagus', 'phytophagous' and 'sharp-snouted') are restricted to the water bodies of the Great Lakes Valley (i.e. Kbodo and Dzavkhan River systems: Borisovets *et al.*, 1985; Shatunovskii, 1985; and see above p. 194).

The two distinct *Oreoleuciscus* species recognised by Vasil'eva (1985) were '... clearly differentiated' on the basis of only a single character: fusion or segmentation and branching of anterior dorsal fin rays (Vasil'eva, 1985: 31, fig. 2). Analysis of this feature among my specimens from the confined population of Boon Tsagaan Nuur, revealed it to be ontogenetically variable; this seriously diminishes its diagnostic value.

The fishes of Boon Tsagaan Nuur were originally identified by Dashdorzh *et al.* (1969) as *Oreoleuciscus pewzowi*. The morphological variability of the specimens caught during this survey supports the view of a single morphologically plastic species and they are identified as the 'lake form' of *O.potanini*. This species susceptibility to sexual dimorphism or ecophenotypic variation is recognised and associated with ontogenetic stage and reproductive state, or food source and other environmental stresses.

A morphocline of intermediate stages, transitional between the forms described by Shatunovskii (1983) can be clearly recognised and lends support to the view of Borisovets *et al.* (1985) and Shatunovskii (1985) of a distinct 'lake form' in Boon Tsagaan Nuur. This 'form' appears to be present in other Gobi Valley lakes (e.g. Tsatsin Tsagaan Nuur) as specimens collected by the American Museum Asiatic Expedition (see Andrews, 1932 and AMNH specimens 10915, 10918, 11052, 11055, 11057, 11059, 11068, 11094 & 11111) exhibit a similar range of characters.

Unfortunately, I have not had the opportunity to examine *Oreoleuciscus* material from the Great Lakes Valley of Western Mongolia (i.e. the 'ichthyophagous', 'phytophagous' or 'sharp-snouted forms').

***Oreoleuciscus potanini* Kessler, 1879**
'Dwarf Form'

Fig. 15

Fig. 16 *Lagowskiella czekanowskii*, lateral views (23–60 mm SL; BMNH 1986.8.28: 820–1045).

MATERIAL. FS 1, 1986.8.28: 1046–1047 (42 & 49 mm); FS 2, 1986.8.28: 1048–1053 (52–65 mm; 1 ex. double stained). Total 8 specimens*.

VARIATION. Conform to the concept of a 'dwarf form' of *Oreoleuciscus potanini* as described by Borisovets *et al.* (1984 & 1985, and see Shatunovskii, 1985).

GEOGRAPHICAL RANGE. Isolated water bodies of the Gobi Valley, Mongolia.

ECOLOGICAL NOTES. These specimens were caught along the shore of Biger Nuur. This small endorheic lake lies several hundred kilometres apart from other water bodies in the western region of the Gobi Valley system and is prone to periodic dessication.

* This 'form' of *O.potanini* previously unrepresented in collection of BMNH.

TAXONOMIC DISCUSSION. Superficially these small fishes resemble *Phoxinus*, however, osteological analysis revealed that their long head, nasals and jaws, depressed cranium, somewhat divergent infraorbital canal, well developed supraneurals and exceedingly small scales, all clearly distinguish these taxa. These features are more typical of *Oreoleuciscus* and to some extent *Lagowskiella* as well (see below p. 197 and Howes, 1985), although, my specimens can be distinguished from this genus by a higher number of gill-rakers (12–15) and wider bucco-pharyngeal opening. The striking similarity between the 'dwarf form' of *Oreoleuciscus potanini* and *Lagowskiella* (e.g. *L.czekanowskii* see below p. 197) questions the proposed sister group relationship between this genus and the aspinine cyprinids generally as suggested by Howes (1984).

At the present time *Oreoleuciscus* and *Lagowskiella* are

Fig. 17 *Rhynchocypris steindachneri*, lateral view (136 mm SL; BMNH 1986.8.28: 1055).

zoogeographically isolated in distinct drainage basins (Central Asian and Pacific, respectively) which may once have been part of the continuous watershed that extended across central Asia (see earlier section).

The monospecific fish fauna of Biger Nuur and other isolated Gobi Valley lakes make them ideal 'natural laboratories' for investigating epigenetic processes governing ecophenotypic variation or for productivity studies of short, relatively uncomplicated lacustrine food chains.

Lagowskiella czekanowskii Dybowski, 1916

Fig. 16.

MATERIAL. NS 43, 1986.8.28: 796–819 (16–48 mm); RS 7, 1986.8.28: 820–1045 (20–60 mm). Total 251 specimens.

VARIATION. Conform to the diagnosis given by Berg (1948: 117) and Shatunovskii (1983: 161) for *Phoxinus czekanowskii*.

GEOGRAPHICAL RANGE. The Amur River basin including tributaries in northern China, the USSR and eastern Mongolia.

ECOLOGICAL NOTES. Within Mongolia this species appears to be confined to waters of the Pacific basin. During the course of this survey it was collected from inlets and ponds in the flood plain of Herelen Gol. Although Arctic basin localities have been recorded (Berg, 1948; Shatunovskii, 1983: 161), they were for sub-species which cannot be adequately defined by material that is available at present.

TAXONOMIC DISCUSSION. Following the critical analysis by Howes (1985), of genera recognised as synonyms of *Phoxinus* by Berg (1912 & 1948), *Lagowskiella* and *Rhynchocypris* (see below) are accorded separate generic status. In the opinion of Howes (1985: 63) *Lagowskiella* '... shares none of the derived characters that define *Phoxinus*' and, furthermore, can be distinguished by a broader and longer post-orbital region, a more elongate body and posteriorly placed anal fin, several osteological characters, a higher modal vertebral number and an apomorphic gill-raker morphology. He tentatively assigned six species to *Lagowskiella*. *L.czekanowskii* is distinguished principally by its attenuated opercular border and divergent infraorbitals. The morphology of the gill-raker membrane could not be ascertained from the two poorly preserved specimens available to Howes (1985: 67), but has now been examined in these specimens. Their prominent genital papillae are similar to the condition of these organs in *L.lagowskiella* described by Howes (1985: fig. 8).

Rhynchocypris steindachneri (Sauvage, 1883)

Fig. 17

MATERIAL. NS 52–53, 1986.8.28: 1054 (110 mm); NS 56, 1986.8.28: 1055 (136 mm); NS 57, 1986.8.28: 1056 (115 mm). Total 3 specimens.

VARIATION. Lie within the range of morphometric and meristic characters given for this species by Howes (1985: table 1).

GEOGRAPHICAL RANGE. The Amur River basin including tributaries in northern China, the USSR and eastern Mongolia. Its occurrence in Mongolia is recorded here for the first time and extends the known geographical range for the species.

ECOLOGICAL NOTES. Within Mongolia the species is confined to waters of the Pacific basin. The specimens reported upon here were collected from the main stream of the Herelen Gol and a tributary meandering across its flood plain (see above p. 188).

TAXONOMIC DISCUSSION. Three closely related *Rhynchocypris* species were recognised by Howes (1985: 60). This followed his critical review of genera placed in synonymy with *Phoxinus* by Berg (1948) and subsequent authors (e.g. Shatunovskii, 1983 & 1985 and see Howes, 1985: 60 for list of others).

Exclusion of this distinctive taxon from synonymy was based upon the presence of several apomorphic characters, including '... a fleshy rostral process, most highly developed in ripe females (fig. 4), hypertrophied olfactory lamellae with crenate ventral margins, attenuated posterior border of the operculum and a distinct notch on the dorsal border of the

Fig. 18 *Phoxinus phoxinus*, lateral view (54 mm SL: BMNH 1986.8.28: 582–655).

upright part of the cleithral lamellae' (Howes, 1985: 60, fig. 4).

Rhynchocypris steindachneri can be distinguished from its sister species by a shorter head, greater interorbital width and lower scale count. A colour pattern consisting of a dark region around the snout and head that extends posterolaterally as dark mottling overlying a deep lateral band (Howes, 1985: 60, fig. 5a) is also unique to this species. Howes's description was based upon material held at the United States National Museum, Washington and four Japanese specimens in the collections at the BMNH (1907.12.23: 11–14).

Rhynchocypris costatus (Fowler, 1899)

MATERIAL. NS 43, 1986.8.28: 1057 (43 mm); NS 52, 1986.8.28: 1058 (52 mm); RS 7. 1986.8.28: 1059 (40 mm). Total 3 specimens.*

VARIATION. Morphometric and meristic characters conform with those given by Howes (1985: table 1) for this species.

GEOGRAPHICAL RANGE. This species is confined to waters of the Amur River basin. This is the first record from Mongolia and extends the known geographical range of the species.

ECOLOGICAL NOTES. Collected in the main stream and side channels of Herelen Gol.

TAXONOMIC DISCUSSION. *Rhynchocypris costatus* can be distinguished from *R. steindachneri* by a generally more elongate body, longer operculum, and higher vertebral number. The colour pattern consists of a little mottling above a deep lateral band, as described by Howes (1985: 60). His account was based on material in the collection of the AMNH including specimens used by Fowler (1899) for the original description of the species.

Phoxinus phoxinus (Linnaeus, 1758)

Fig. 18

MATERIAL. RS 1, 1986.8.28: 582–655 (12–54 mm); NS 18, 1986.8.28: 656–734 (16–48 mm); NS 32–35, 1986.8.28: 735–786 (25–54 mm); NS 43, 1986.8.28: 787–788 (21–50 mm); NS 56, 1986.8.28: 789–793 (37–43 mm); RS 7, 1986.8.28: 794 (36 mm). Total 213 specimens.

VARIATION. Lie within the range of morphometric and meristic characters given for *P.phoxinus* by Berg (1948), Holčík & Pivnička (1969) and Shatunovskii (1983).

GEOGRAPHICAL RANGE. This widespread Eurasian species is found from the British Isles and France (Wheeler, 1969) across central Europe, the USSR, Mongolia, China and North Korea.

ECOLOGICAL NOTES. In Mongolia is distributed in waters of the Arctic and Pacific basins and was collected during the course of this survey from the Orkhon Gol, Tamir Gol and Herelen Gol (including a little pond in water meadow bordering the main river). The species appears to prefer cold, clear water running over a sand and stone substrate and was often caught together with *Noemacheilus*, *Misgurnus* and young salmonids.

TAXONOMIC DISCUSSION. Since the taxonomic changes proposed by Howes (1985: 71) this is now the only *Phoxinus* found in Mongolian waters. Mongolian species previously allocated to this genus include *P.percnurus*, *P.lagowskii* and *P.czekanowskii* (see Berg, 1948 and Shatunovskii, 1983). Reasons for their exclusion from *Phoxinus* are given by Howes (1985) and these species are now referred to *Eupallasella percnurus*, *Lagowskiella lagowskii* (discussed on p. 197) and *L.czekanowskii* (discussed on p. 197).

Gobio gobio cynocephalus Dybowski, 1869

Fig. 19

MATERIAL. NS 43, 1986.8.28: 1060–1061 (21–22 mm); NS 56, 1986.8.28: 1062 (107 mm); RS 7, 1986.8.28: 1063–1070 (20–32 mm). Total 11 specimens.

VARIATION. Apart from one, all are juvenile and the value of morphometric diagnoses are diminished by ontogenetic variation. The adult specimen (107 mm) lies within the range of morphometric and colour descriptions given by Berg (1948), Holčík & Pivnička (1969) and Shatunovskii (1983).

GEOGRAPHICAL RANGE. This subspecies is recorded in Siberian waters from the Ob and Yenesei Rivers, to the Amur and Liao Rivers in northern China.

* Species previously unrepresented in collection of BMNH.

Fig. 19 *Gobio gobio cynocephalus*, lateral view (107 mm SL: BMNH 1986.8.28: 1062).

Fig. 20 *Carassius auratus gibelio*, lateral view (306 mm SL; BMNH 1986.8.28: 1071).

ECOLOGICAL NOTES. Within Mongolia is confined to Pacific draining waters and was caught during this survey from Herelen Gol; it is also recorded from the Onon and Khalkhin Gols (Shatunovskii, 1983).

TAXONOMIC DISCUSSION. The largest specimen reported upon here and those recorded by Holčík & Pivnička (1969) contradict the opinion expressed by Shatunovskii (1983) that in Mongolian waters this species only '... reaches the length of 6 cm'.

The other *Gobio* species recorded from Mongolia are *G.albipinnatus* and *G.soldatovi*; they are also found in the Pacific basin, but are confined to the Onon and Khalkin Rivers, respectively. *G.albipinnatus* is distinguished by its colourless dorsal fin (Taranets, 1937; Berg, 1948; Holčík & Pivnička, 1969) and *G.soldatovi* by fewer scales in the lateral line and a continuous dark lateral band in place of the distinct series of 8–11 dark spots typical of *G. gobio cynocephalus*.

Hitherto, this subspecies was only represented in the BMNH by three specimens (1898.4.26: 24–26) donated by the Paris Museum in 1898 as part of a collection from Central Asia made by Mr M. Chaffargon.

Carassius auratus gibelio (Bloch, 1783)

Fig. 20

MATERIAL. NS 12, 1986.8.28: 1071 (306 mm); NS 57, 1986.8.28: 1074 (95 mm); RS 7, 1986.8.28: 1077–1104 (30–55 mm). Total 30 specimens.

VARIATION. Conform to the description given in Berg (1948: 385) and Shatunovskii (1983 & 1985).

GEOGRAPHICAL RANGE. The natural geographical range of *C.auratus gibelio* extends from eastern Europe to China, although now, it is widespread throughout most of Europe (Wheeler, 1969) and North America (Scott & Crossman, 1973) by introduction.

ECOLOGICAL NOTES. Within Mongolia occurs in Arctic and Pacific drainage systems, in densely vegetated ponds, lakes and slow flowing rivers; caught during this survey in Ugiy Nuur and Herelen Gol.

TAXONOMIC DISCUSSION. Is distinguished from the nominate subspecies by the latter's somewhat larger scales (26–31 in

Fig. 21 *Noemacheilus barbatulus toni*, lateral view (100 mm SL: BMNH 1986.8.28: 1167).

Fig. 22 *Noemacheilus strauchi*, lateral view (50 mm SL; BMNH 1986.8.28: 1171–1178).

lateral line). *Carassius auratus auratus* occurs naturally in Eastern China, the outlying islands Hainan and Taiwan, Korea and Japan. These *C.auratus* subspecies are clearly distinguished from *Carassius carassius* by a higher number of gill rakers on the 1st branchial arch (39–50), fewer lateral line scales (28–31), deeply serrated dorsal and anal fin spines (Berg, 1948: 378, fig. 564 and Wheeler, 1969: 187), usually five branched anal fin rays and a slightly less deep body.

This material joins one specimen (1898.4.26: 23) already deposited in the BMNH from a collection made by Mr M. Chaffargon and three (1905.2.2: 8–11) collected by C. W. Campbell from 'N.E. Mongolia'.

Cyprinus carpio haematopterus (Temminck & Schlegel, 1842)

MATERIAL. NS 52–53, 1986.8.28: 1072–1073 (89–91 mm); NS 57, 1986.8.28: 1075–1076 (87–94 mm). Total 4 specimens.

VARIATION. Conform with the generic diagnosis given by Berg (1948: 390 & 403) and his description of this subspecies (see also Shatunovskii, 1983: 203).

GEOGRAPHICAL RANGE. Naturally restricted to Eastern Asia from the Amur River basin through Pacific draining waters of China, Korea and Japan.

ECOLOGICAL NOTES. Caught during this survey from Herelen Gol.

TAXONOMIC DISCUSSION. Distinguished from the nominate subspecies by having generally fewer gill rakers on the outer side of the first branchial arch (i.e. 17–25). All specimens caught are juvenile and superficially resemble *C.auratus gibelio*, although close examination revealed the presence of four barbels (2 each side of mouth), a larger base of the dorsal fin and a higher number of lateral line scales (36–39).

Is only the second specimen from this region to be deposited at the BMNH; the first (1905.2.2: 7) was collected by C. W. Campbell.

HOMALOPTERIDAE

Noemacheilus barbatulus toni (Dybowski, 1869)

Fig. 21

MATERIAL. RS 1, 1986.8.28: 1105–1108 (25–56 mm); NS 17–18, 1986.8.28: 1109–1112 (30–40 mm); NS 20, 1986.8.28: 1113–1122 (34–90 mm); NS 21, 1986.8.28: 1123–1136 (47–105 mm); NS 32–35, 1986.8.28: 1137–1166 (30–62 mm); NS 37, 1986.8.28: 1167 (100 mm); NS 56, 1986.8.28: 1168 (29 mm). Total 64 specimens.

VARIATION. Some variation from description given by Berg (1948: 433) considered to be geographically localised and the specimens generally conform to his diagnosis and that of Shatunovskii (1983: 207). These authors are followed here but future attention must be given to pending nomenclatural changes proposed for homalopterid genera (A. C. Wheeler, *pers. comm.*).

GEOGRAPHICAL RANGE. Occurs in Siberia from the Ob River eastwards to the Kolyma, Yalu and Liao Rivers in China and is also found in Korea and northern Japan. Sawada (1982: 203, fig. 106) gives a detailed distribution of the genus, which has the widest range of all cobitoid genera.

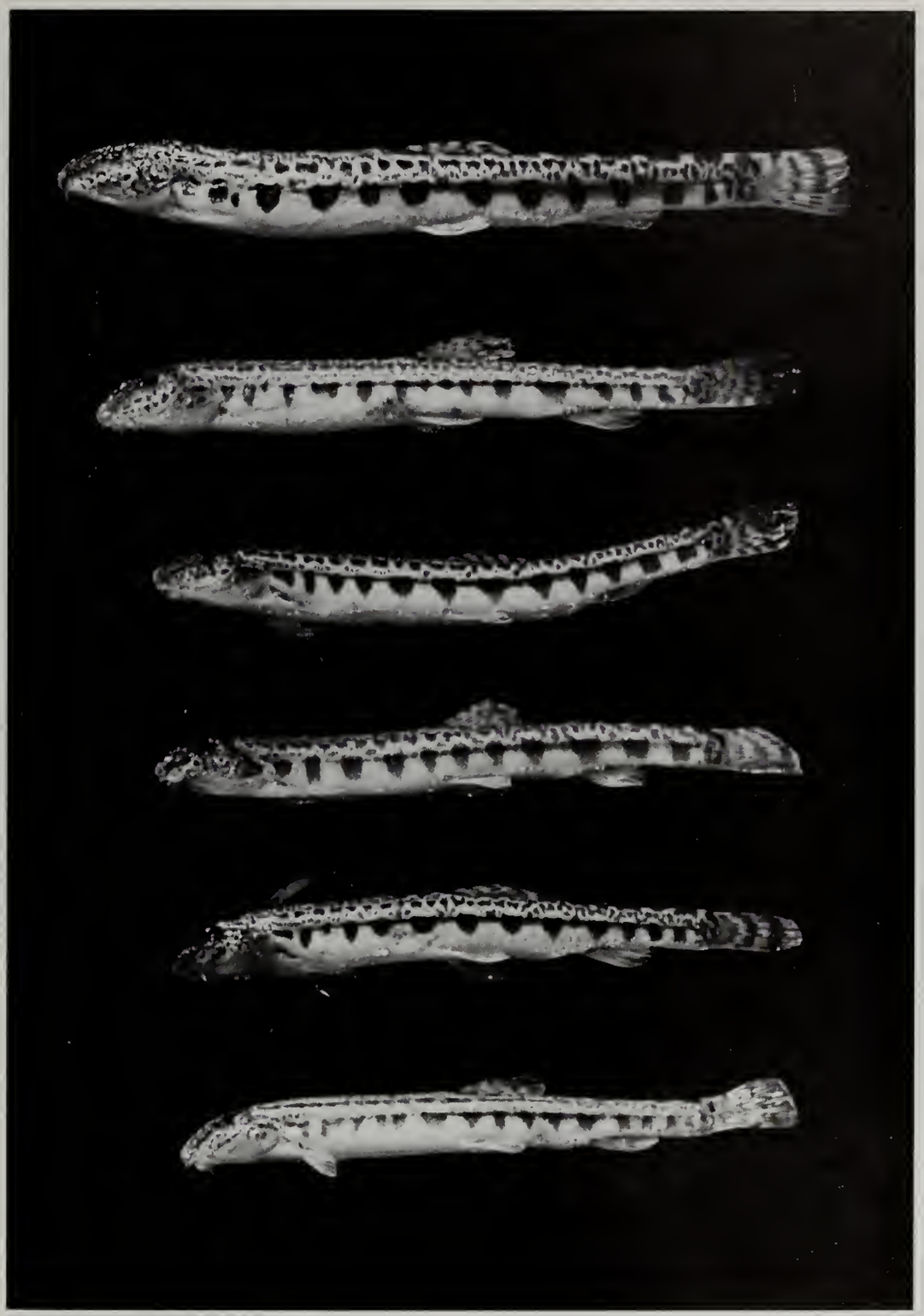


Fig. 23 *Cobitis taenia*, lateral view (53–68 mm SL; BMNH 1986.8.28: 1222–1238).

ECOLOGICAL NOTES. In Mongolia it is restricted to waters of the Arctic and Pacific basins (collected from the Orkhon, Tamir, Terilg and Herelen Gol) and is one of two *Noemacheilus* species present.

TAXONOMIC DISCUSSION. The European nominate subspecies (*N. barbatulus barbatulus*; see Sawada, 1982: fig. 93) can be distinguished by the presence of minute scales on the anterior region of its body; they are sparse or entirely absent in *N.barbatulus toni* (Berg, 1948: 422).

Following the revisionary studies of Sawada (1982; see also Parshall, 1983), noemacheiline loaches '... must now be transferred from the Cobitidae to Homalopteridae' (Sawada, 1982: 183) and are given separate subfamilial status: Noemacheilinae.

Noemacheilus comprises more than 100 nominal species. Attempts have been made to subdivide the genus (e.g. Berg, 1948; Bănărescu & Nalbant, 1964, 1966, 1968, 1974 & 1976). Berg's (1948: 411) subgenera *Noemacheilus* (*Deuterophya* and *N.(Noemacheilus)* were based on incomplete versus entire encapsulation of the swim-bladder in an ossified matrix. Further analysis of this character has revealed the existence of a clear morphocline between these two conditions (Sawada, 1982; Parshall, 1983). For the present, in the opinion of Sawada (1982: 202), all species should be retained in *Noemacheilus*. Unfortunately, he did not have access to

Fig. 24 *Misgurnus anguillicaudatus*, lateral views (32–69 mm SL; BMNH 1986.8.28: 1246–1285).

specimens of the species included by Berg in his *Deuterophysa* (e.g. *Noemacheilus strauchi*, *N.labiatus* or *N.dorsalis*) and their relationships to those distinct *Noemacheilus* lineages tentatively proposed by Sawada (1982: 193, fig. 99) must await future analyses.

Noemacheilus strauchi (Kessler, 1874)

Fig. 22

MATERIAL. RS 2, 1986.8.28: 1169–1170 (26–30 mm); RS 3–4, 1986.8.28: 1171–1178 (45–54 mm); RS 3–4, 1986.8.28: 1179–1187 (43–64 mm); RS 3–4, 1986.8.28: 1188–1197 (39–51 mm); RS 3–4, 1986.8.28: 1198–1208 (47–66 mm). Total 40 specimens.

VARIATION. Lie within the range of the descriptions given by Berg (1948: 412), Holčík & Pivnička (1969: 12, figs. 4–7) and Shatunovskii (1983: 210). No specimens were found with a body length exceeding 70 mm. The large sizes recorded by Berg (1948: 412, for specimens from Malyi Saryehegan, Bay of Balkash) were not encountered during this survey.

GEOGRAPHICAL RANGE. Holčík & Pivnička (1969) were first to discover this species in Mongolia and recorded it from '. . . the salt Sangin-dalai lake and Teisingol river'. This locality was also given by Shatunovskii (1983: 210). These isolated water bodies lie within the northern region of the west Mongolian Great Lakes Valley (see p. 179) of the Internal or Central Asian basin. The specimens listed above are the first of this species to be recorded from the Gobi Valley region of the Central Asian basin. Their presence adds support to the faunal uniformity of this zoogeographical province.

ECOLOGICAL NOTES. *Noemacheilus strauchi* was caught in the Tsagaan Gol and tributaries, before this freshwater stream entered the endorheic waters of Boon Tsagaan Nuur; no specimens were caught or observed in the lake waters. It is geographically isolated from the other member of this genus found in Mongolia (i.e. *N.barbatulus toni*) which is confined to the Arctic and Pacific basins.

TAXONOMIC DISCUSSIONS. *N.strauchi* is distinguished from *N.barbatulus toni* by being entirely scaleless and by a portion of its swimbladder lying within the abdominal cavity. The swimbladder is entirely enclosed in a bony capsule in *N. barbatulus toni*, which is also, at least partly, covered in small scales.

The inclusion of this species in *Noemacheilus* must only be retained provisionally. Sawada (1982) has shown that the numerous species presently comprising this genus can be divided into several, apparently monophyletic, lineages.

COBITIDAE

Cobitis taenia Linnaeus, 1758

Fig. 23

MATERIAL. RS 1, 1986.8.28: 1209–1215 (40–58 mm); NS 17–18, 1986.8.28: 1216–1220 (49–72 mm); NS 20, 1986.8.28: 1221

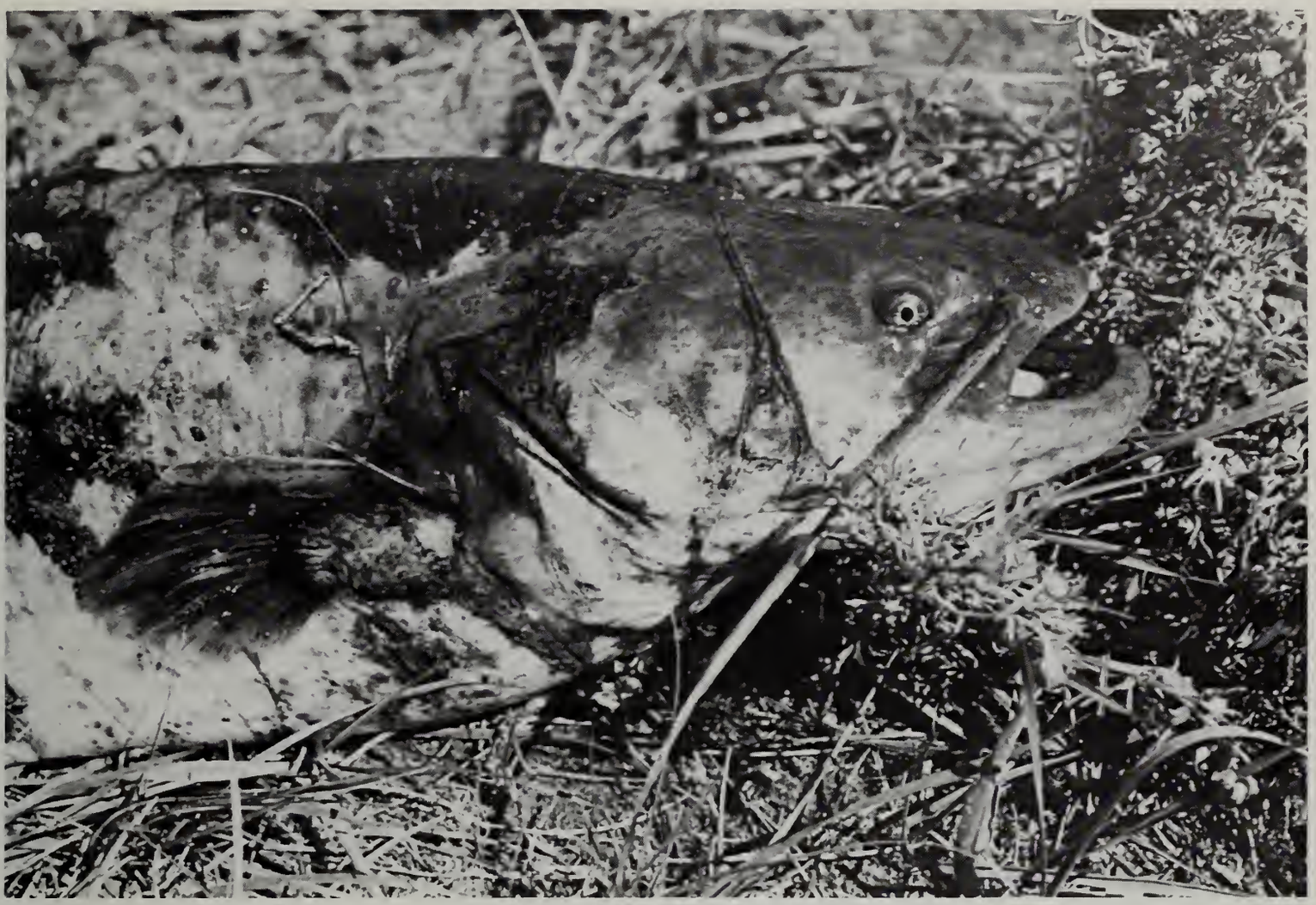


Fig. 25 *Silurus asotus*, lateral view of head region (665 mm SL; BMNH 1986.8.28: 1287).

(56 mm); NS 32–35, 1986.8.28: 1222–1238 (53–73 mm); NS 43, 1986.8.28: 1239–1244 (52–79 mm); NS 56, 1986.8.28: 1245 (60 mm). Total 37 specimens.

VARIATION. Morphometric and meristic characters conform to the descriptions in Berg (1948: 455) and Shatunovskii (1983.)

GEOGRAPHICAL RANGE. Widespread Eurasian species, ranging from western Europe (Wheeler, 1969) to the eastern China seaboard (Nichols, 1943); see Sawada (1982: 199, fig. 103) for detailed distribution of the genus.

ECOLOGICAL NOTES. Within Mongolia is confined to waters of the Arctic and Pacific basins; in flowing and stagnant waters with silty and muddy substrate. Caught during this survey in Orkhon Gol, Tamir Gol, Terilg Gol and Herelen Gol.

TAXONOMIC DISCUSSION. A Siberian subspecies (Gladkov, 1935) in which head length is equal or only slightly longer than the caudal peduncle (Berg, 1948: 459), can be clearly distinguished from *Cobitis taenia* in which head length far exceeds caudal peduncle length.

Misgurnus anguillicaudatus (Cantor, 1842)

Fig. 24

MATERIALS. NS 43, 1986.8.28: 1246–1285 (20–81 mm); RS 7, 1986.8.28: 1286 (36 mm). Total 41 specimens.

VARIATION. Conform to the description in Berg (1948: 467).

GEOGRAPHICAL RANGE. Is confined to the basin of the Amur River.

ECOLOGICAL NOTES. In Mongolia is found only in Pacific draining waters. It was caught during this survey in tributaries and ponds of the Herelen Gol.

TAXONOMIC DISCUSSION. This species was considered to be subspecifically distinct from the taxon *M.fossilis* by Nicholski (1956); a view adopted by Shatunovskii (1983: 213). However, Sawada (1982) retained them as two distinct species on the grounds that they exhibit unique osteological characters. His distinction is followed here, although it is recognised that the species within this genus are in need of revision. The discontinuous geographical range of the genus is given by Sawada (1982: 198, fig. 102).

SILURIDAE

Silurus asotus Linnaeus, 1758

Fig. 25

MATERIAL. NS 12, 1986.8.28: 1287 (665 mm). Total 1 specimen.

VARIATION. Conforms to the description of this species given in Berg (1948: 475), Holčík & Pivnička (1969: 16) and Shatunovskii (1983: 214–216 & 1985: 151).

GEOGRAPHICAL RANGE. This species is the only catfish recorded from Mongolia and was considered by Berg (1948:

475) to be confined to waters of the Amur basin. However, Dulma (1979: table 3) listed it among species found in lakes within the Arctic basin as well.

ECOLOGICAL NOTES.During the course of this survey, the species was caught in Ugiy Nuur. This confirms its presence outside the Amur basin and a distribution within Mongolia extending across Arctic as well as Pacific draining waters.

Gut contents analysis revealed the diet of this piscivorous species in Ugiy Nuur to be juvenile *Perca* and *Leuciscus*. A single juvenile *Perca* (40 mm) was found in the stomach of the preserved specimen reported upon here. A prominent genital papilla is also exhibited by this specimen.

TAXONOMIC DISCUSSION. Berg (1948) and most subsequent authors followed the reallocation of the species to the genus *Parasilurus*. This was originally suggested by Bleeker (1862: 393) largely on the basis of it possessing only two pairs of barbels in place of three in most *Silurus* species. Haig (1952) revised the Oriental and Palaearctic Siluridae and analysed this and other characters used to separate these genera. She concluded that 'It does not seem advisable to separate genera on the basis of a character which is dependent upon physiological growth factors. Especially ... since it can be shown that in small populations of usually 4-barbelled forms, a few individuals may appear with 6 barbels.' In coming to this conclusion based on the ontogenetic variability of barbel numbers, Haig (1952: 72) cited the work of several earlier authors including Atoda (1935), Kimura (1935), Hora (1936) and Bhimachar & Rau (1941).

Berg (1948: 476) noted the presence of three pairs of barbels in larval *Silurus asotus* (as described by Soin, 1947) but considered the adult condition adequate to define a distinct genus. However, his descriptions do not reveal any character that is unique to *Parasilurus*. He even noted that the smooth pectoral fin spines are prone to vary intraspecifically thereby diminishing the value of this character. The synonymy of *Parasilurus* as proposed by Haig (1952) is, therefore, upheld and the Mongolian silurid catfish recognised as *Silurus asotus*

Previously this species was represented in the BMNH by a single specimen collected by Mr M. Chaffargon (1898.4.26: 9) from the Herelen Gol and another collected by C. W. Campbell (1905.2.26: 6) from 'N.E. Mongolia'.

GADIDAE

Lota lota (Linnaeus, 1758)

MATERIAL. NS 40, 1986.8.28: 1288 (376 mm); NS 41, 1986.8.28: 1289–1290 (257–289 mm); NS 56, 1986.8.28: 1291 (180 mm). Total 4 specimens*

VARIATION. Conform to the descriptions and range of morphometric and meristic characters given for the species by Berg (1948), Holčík & Pivnička (1969: 18), Wheeler (1969: 283), Scott & Crossman (1973: 641–645) and Shatunovskii (1983: 216–218 & 1985: 158–161).

GEOGRAPHICAL RANGE. This monotypic genus is distributed in the freshwaters of North America and continental Eurasia, from western France, the eastern region of England (where the lack of reliable, recent records suggests that it may now be extinct), across the USSR to the Amur River and its southern Chinese tributaries (Berg, 1948; Wheeler, 1969; Scott & Crossman, 1973).

ECOLOGICAL NOTES. In Mongolia *Lota* is widespread throughout rivers and lakes (see Dulma, 1979: table 3) in the Arctic and Pacific draining waters and was caught during this survey in representative localities (i.e. Tamir Gol and Herelen Gol) from both basins. Analysis of their gut contents revealed a predominance of caddis fly larvae, molluscs and leeches amongst general debris of aquatic insects, plant material and small stones; these suggest a benthic feeding habit. The gut was particularly densely packed in the two medium sized specimens; the smaller (257 mm) containing twelve leeches (up to 15 mm long) and the larger (289 mm) numerous densely packed caddis fly and other larvae. This supports the view that *Lota* is a voracious predator and night feeder. However, no fish remains were detected even in the largest specimen (376 mm).

TAXONOMIC DISCUSSION. Two subspecies were thought to occur in North America (Hubbs & Schultz, 1941) and parts of north-eastern Siberia (Berg, 1948). However, in the opinion of Scott & Crossman (1973: 642) '... in the present state of our knowledge, the recognition of subspecies seems unwarranted.'

PERCIDAE

Perca fluviatilis Linnaeus, 1758

Fig. 26

MATERIAL. NS 5–6, 1986.8.28: 1292 (310 mm); NS 7, 1986.8.28: 1293–1352 (33–55 mm); NS 10–11, 1986.8.28: 1353 (222 mm); NS 13, 1986.8.28: 1354–1403 (31–47 mm); NS 14, 1986.8.28: 1404 (244 mm); NS 15, 1986.8.28: 1405–1406 (149–158 mm). Total 115 specimens.

VARIATION. Conform to descriptions in Berg (1948: 105), Wheeler, (1969: 322) and Shatunovskii (1983: 218 & 1985: 161).

GEOGRAPHICAL RANGE. This species has a wide Eurasian distribution continuous from France and England eastwards across continental Europe and the USSR to northern Mongolia (Collette & Bănărescu, 1977).

ECOLOGICAL NOTES. Is confined in Mongolia to the Arctic drainage basin and was found to be abundant in Ugiy Nuur, see Dulma (1979: table 3) for further localities of this principally lacustrine species. It is absent from the Amur River system and Pacific draining waters of Mongolia.

This predatory species is carnivorous and often cannabalistic as shown by gut contents analysis of the largest specimen (310 mm); it contained 17 juvenile perch ranging in size from 4 or 5 to 30 mm.

TAXONOMIC DISCUSSION. The perch of North America (*Perca flavescens*) has long been considered a distinct, albeit closely related species. However, Svetovidov & Dorofeeva (1963) concluded that there is only a single circumpolar species. Their conclusion was supported by Thorpe (1977); following extensive morphological, physiological, ecological and behavioural comparisons he concluded, from '... overwhelming

* These four specimens represent the first from Asian waters to be deposited at the BMNH.

Fig. 26 *Perca fluviatilis*, lateral view (244 mm SL; BMNH 1986.8.28: 1404).

similarities ... it seems prudent to regard the two fishes as functionally the same.' This proposed synonymization has not been unanimously accepted (e.g. see Scott & Crossman, 1973: 756). Most recently, Collette & Bănărescu (1977) have found a morphological character (position of the predorsal bone) by which the two species can be invariably distinguished and cite this and a number of additional characters to '... verify the validity of *P.flavescens*'.

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